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SEARCH REQUEST FORM **Scientific and Technical Information Center - EIC2800**

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Date 3/8/2005 Serial # 09/874026 Priority Application Date 06/06/01

Your Name Mark Consilvio Examiner # 80427

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Where have you searched so far on this case?

Circle: USPT DWPI EPO Abs JPO Abs IBM TDB

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What relevant art have you found so far? Please attach pertinent citations or Information Disclosure Statements.

What types of references would you like? Please checkmark:

Primary Refs ___ Nonpatent Literature ✓ Other Web articles (with date)

Secondary Refs ___ Foreign Patents ___

Teaching Refs ___

What is the topic, such as the **novelty**, motivation, utility, or other specific facets defining the desired **focus** of this search? Please include the concepts, synonyms, keywords, acronyms, registry numbers, definitions, structures, strategies, and anything else that helps to describe the topic. Please attach a copy of the abstract and pertinent claims.

The invention concerns Telescope Equatorial Platform Mounts

Focus: (1) contoured bearing surface (to correct for rotation of the Earth)

(2) adjustable support hinges (to allow the platform to be used at different latitudes)

Other inventors: Chuck Shaw, Alan Gee, Tom Osypowski, Georges d'Autume

NPL: Sky + Telescope, Internet, or other telescope magazines

Key words: telescope, equatorial, platform, mount, contour, bearing latitude...

Staff Use Only

Searcher: HARRISON

Searcher Phone: 22511

Searcher Location: STIC-EIC2800, JEF-4B68

Date Searcher Picked Up: 3-17-05

Date Completed: 3-18-05

Searcher Prep/Rev Time: 98

Type of Search

Structure (#) ___

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Litigation ___

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Basic Search

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dobsonian OR poncet AND bearing AND (contouring) Search

☑ All journal sources ☑ All Web sources ☐ Exact phrase

Searched for:: All of the words:**dobsonian** OR **poncet** AND **bearing** AND (**contouring**)

Found:: :**5 total | 1 journal results | 4 Web results**

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Or refine using:

All of the words

refine

☐ **1.** Woodware Designs -- Hards Telescope
Dec 2004
...6 inch, f/8 Newtonian reflector on a **Dobsonian** mount. It is a great first scope, or...piece of tube. If you do a good job of **contouring**, no further shimming or adjusting of...attached, using a flush-trim bit with ball-**bearing**. You now have an MDF disk taped to a...
[http://www.charm.net/~jriley/sky/hardstel.html]
similar results

☐ **2.** BioRome Meeting
Aug 2003
...genetic-algorithm-neural-network approach. J. I. Jaremko*,P. **Poncet**,J. Ronsky,J. Harder,J. Dansereau, H. Labelle,R.F.Zernicke...Tomita, K. Ikeuchi.(Japan)ORAL 94S. Axisymmetric models of load **bearing** in the knee joint:assessment of geometry, stresses and biology...
more hits from [http://www.uwcm.ac.uk/biorome/selectedPapers.htm]
similar results

☐ **3.** No Title
Jul 2002
Undergraduate units 27005 A Foot in Both Camps Level 1. 10 credit points. School of Applied Social & Human Sciences. Autumn Spring (Penrith evening). Since European colonisation, Aboriginal people have lived in many different social realities.
[http://apps.uws.edu.au/uws/calendar/cal_2002/6_ug_unit...]
similar results

☐ **4.** Recognition of eIF4G by Rotavirus NSP3 Reveals a Basis for mRNA Circularization
Groft, C.M. / Burley, S.K., *Molecular Cell*, Jun 2002
...be crosslinked to viral mRNAs in vivo (**Poncet** et al., 1993) and is required for their...found at the 3' ends of rotaviral mRNAs (**Poncet** et al., 1994 Deo et al., 2002) . The C-terminal...eIF4G for translation of rotaviral mRNAs **bearing** the 3' tetra-nucleotide consensus sequence...
Full text article available from SCIENCE@DIRECT
similar results

☐ **5.** BioRome Meeting

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dobsonian OR poncet AND bearing AND (contoured) Search

☑ All journal sources ☑ All Web sources ☐ Exact phrase

Searched for:: All of the words:**dobsonian** OR **poncet** AND **bearing** AND (**contoured**)

Found:: :**10 total** | **1 journal results** | **9 Web results**

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Save checked results Email checked results

Or refine using:
All of the words
refine

☐ **1.** ATM Re: Equatorial Platform
Feb 1998
...the northern edge of the platform (or a worm/**contoured** sector can be attached that has its center...latitude. This shaft will be anchored >in a **bearing** surface (probably a simple roller **bearing**). I felt this >would be more accurate that...
[http://astro.umsystem.edu/atm/ARCHIVES/DEC95/msg00087....]
similar results

☐ **2.** X-ray structure of a bifunctional protein kinase in complex with its protein substrate HPr -- Fieulaine et al. 99 (21): 13437 ...
Sonia Fieulaine / Solange Morera / Sandrine Poncet / Ivan Mijakovic / Anne Galinier, Dec 2004
...Fieulaine * Solange Morera * Sandrine **Poncet** Ivan Mijakovic Anne Galinier...of the red subunit. The 236258 loop **bearing** the arginine is ordered in the phosphorylated...phosphate ion is from an Fo-Fc omit map **contoured** at 2 . The gray sphere is Ca 2+ , and...
[http://www.pnas.org/cgi/content/full/99/21/13437]
similar results

☐ **3.** PRESENTATIONS AT THE 2002 ANNUAL MEETING.doc
Jul 2004
...The Scientific Facts on Alternative **Bearing** Surfaces: Is There a Rational Basis for...information on the use of alternative **bearing** surfaces for joint replacement arthroplasty...scientific rationale for choosing one **bearing** surface over another? There will be ample...
[http://www.aoassn.org/pdf/2002_AM_Presentations.pdf]
similar results

☐ **4.** My Meade 12.5 MBAR Scope
Apr 2004
...solid plastic and **contoured** to fit the tube...teflon altitude **bearings** to keep the tube...mount is a typical **Dobsonian** design using 3/4...the altitude axis **bearing** system... I've spent...effects of different **bearing** materials, spacings...harmony of the **Dobsonian** alt- az system...
[http://home.wmis.net/~rv6/myscope12p5inch.html]
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☐ **5.** Woodware Designs -- Hards Telescope
Dec 2004

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☐ **1.** PART II
Feb 2004
45 Part II: MEASURES, DECISIONS AND RESOLUTIONS ADOPTED AT XXVI ATCM 48 Annex A: Measures 49 Measure 1 (2003) Secretariat of the Antarctic Treaty 50 Measure 2 (2003) Antarctic protected area system: management plans for antarctic specially protected areas.
[http://www.asoc.org/Documents/ATCMXXVI/XXVI%20ATCM%20F...]
similar results

☐ **2.** No Title
Jul 2002
...Surfaces 146 5.3.1 Surface Construction by **Contour** Linking 147 5.3.2 The Technique of Boissonnat...Remarks 252 Appendix 1 - The Problems with **Contour** Linking 254 A1.1 The Problems with **Contour** Linking 254 The Correspondence Problem 254...
[http://www.creatis.insa-lyon.fr/~frog/Curvature/A_Cast...]
similar results

☐ **3.** U.S. Geological Survey Open-File Report 98-126
May 2002
...81654, 88 p. Agapitov, D.I., Ivanov, V.V., and Krainov, V.G., 1973, New data on the geology and prospects in petroleum/gas-**bearing** Anadyr basin: Akademiya Nauk SSR North-East Group Institute of Interior Center Translations, v.49, p. 2329 (in Russian...
[http://pubs.usgs.gov/of/1998/of98-126/of98-126.pdf]
similar results

☐ **4.** What is special about face recognition
Dec 2003
...recognition will necessarily have some **bearing** on the debate concerning domain specificity...Christen, Bogen, & Imhoff, 1986 Michel, **Poncet**, & Signoret, 1989 Tovee & Cohen-Tovee...and their location with respect to the **contours** of the face. For Sergent (1984 Takane...
[http://www.psych.utoronto.ca/~pgsa/Course%20Readings/H...]
similar results

☐ **5.** Visual crowding and category specific deficits for pictoral stimuli: A neural network model
Feb 2003
VISUAL CROWDING AND CATEGORY SPECIFIC DEFICITS FOR

Searched for:: All of the words:**dobsonian** AND **poncet**

Found:: :**42 total** | **0 journal results** | **42 Web results**

Sort by:: :**relevance** | **date**

Save checked results | Email checked results

☐ **11.** CUAS - How to Choose a Scope
Oct 2004
Purchasing Amateur Telescopes FAQ Slc.Dennis Bishop 102063.112@compuserve.com Last Updated: 9707.15 Copyright (c) 1997 Slc.Dennis Bishop All rights reserved.
[http://www.prairienet.org/cuas/scphow2.shtml]
similar results

☐ **12.** Purchasing Amateur Telescopes FAQ
Aug 1998
Pierre Asselin Dana Bunner Doug Caprette Mike Collins Kevin Deane Jay Freeman Chuck Grant Dyer Lytle Christopher Gunn Doug McDonald Andy Michael Dave Nash Jim Van Nuland Bill Nelson Leigh Palmer Alan Peterman Tom Randolph David Smith Geoff Steer Mario Wolczko C.
[http://www.tass-survey.org/richmond/answers/telescope....]
similar results

☐ **13.** No Title
Apr 2003
...Activities: - Design, plan and built the 8" Fitzgerald **Dobsonian** Telescope - Design, plan and built the 8" Barney...and build an Equatorial Tracking platform for **Dobsonian** telescopes (a **Poncet** platform) - Design and build an number of type...
[http://www.path.queensu.ca/~kell/papers/kingstonmanual...]
similar results

☐ **14.** Amateur Telescopes FAQ Part II
Aug 1994
...built an 8" and a 12.5" reflector on **Dobsonian** mounts (of course). We went this way...course, complete details for making a **Dobsonian**. 169 pages 154 clear, friendly line drawings...shows how you can build your own low-cost **Dobsonian** Telescope. The 90-minute video is a complete...
[http://www.hcs.harvard.edu/~stahr/info/scope_faq_2.htm...]
similar results

☐ **15.** No Title
Feb 2004
...1980:5:425 cross-axis in a box 1983:10:351 **Dobsonian**, equatorial tracking 1981:1:85 economical homemade...comet seeking 1978:7:73

Refine your search using these keywords found in the results:
binocular
binoculars
celestial objects
collimation
eyepiece
eye relief
fiberglass
focal length
polar axis
radio telescope
star chart
teflon
telescope makers

Or refine using:
All of the words
[refine]

Basic Search

Advanced Search Search Preferences

dobsonian poncet [Search]

☑ All journal sources ☑ All Web sources ☐ Exact phrase

Searched for:: All of the words: **dobsonian** AND **poncet**

Found:: :**42 total** | **0 journal results** | **42 Web results**

Sort by:: :**relevance** | **date**

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☐ **1.** Re: ATM Equilatorial or Poncet Platform for Dobsonian...
Feb 1998
...ATM Equilatorial or **Poncet** Platform for **Dobsonian**... To bergrd@valunet...ATM Equilatorial or **Poncet** Platform for **Dobsonian**... From cshaw@ghgcorp...ATM Equilatorial or **Poncet** Platform for **Dobsonian**... Next by thread: ATM...
more hits
from [http://astro.umsystem.edu/atm/ARCHIVES/DEC96/msg00023....]
similar results

☐ **2.** Jan: Astronomy dobsonian tips
Jan 2005
...Also problems can occur when using a **poncet** mount: when the azimuth bearings have...telescope in azimuth. With my 12 inch f/6 **dobsonian** I have experienced both problems and this...I used this method in my (two-sector) **poncet** mount, with very satisfying results...
[http://home.wanadoo.nl/jhm.vangastel/Astronomy/tips.ht...]
similar results

☐ **3.** Dobsons
Oct 2004
...Frédéric Géa The origin of the **Dobsonian** Big scope observing Why make a dobson...obstacles have been overcome. A **Dobsonian** of 400 mm is not impossible to move, nor out of price. One can build a **Dobsonian** with equal budget to a manufactured...
more hits
from [http://www.astrosurf.com/altaz/telescopesdobson_e.htm]
similar results

☐ **4.** Dobsons
Nov 2004
...Frédéric Géa The origin of the **Dobsonian** Big scope observing Why make a dobson...obstacles have been overcome. A **Dobsonian** of 400 mm is not impossible to move, nor out of price. One can build a **Dobsonian** with equal budget to a manufactured...
[http://www.astrosurf.org/altaz/telescopesdobson_e.htm]
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binoculars
celestial objects
collimation
eyepiece
eye relief
fiberglass
focal length
polar axis
radio telescope
star chart
teflon
telescope makers

Or refine using:

All of the words ▾

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Did you mean: equatorial johnson telescope bearing contour OR contours OR ***contour*** OR contouring

[PDF] Sloan Digital Sky Survey 2003 ANNUAL REPORT 26 November 2003
File Format: PDF/Adobe Acrobat - View as HTML
... Survey of Southern **Equatorial** Stripe 32,468 34,284 9,016 8,089 629 ... We experienced several **telescope** drive **bearing** failures in the latter part of the year ...
tdserver1.fnal.gov/sdss/project/ annual_reports/2003-annual-report.pdf - Similar pages

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... With the addition of Space **Telescope** Imaging Spectrograph (STIS ... in Figure 5. Over Io's **equatorial** belt with ... by plasma heating (Wong and **Johnson**, 1995), our ...
www.kluweronline.com/article.asp?PIPS=353302&PDF=1 - Similar pages

[PDF] 201351 601..611
File Format: PDF/Adobe Acrobat
... in this study were obtained in the **Johnson** V bandpass ... obtain the pixel scale and, eg, **equatorial** coordinates ... The Mayall 4 m **telescope** prime focus field corrector ...
www.journals.uchicago.edu/AJ/ journal/issues/v124n1/201351/201351.web.pdf - Similar pages

Complete Book of Spaceflight: list of entries
... SUVO (Space Ultraviolet Optical **Telescope**) SWAS (Submillimeter Wave ... Flight Center (GSFC) **Johnson** Space Center ... elliptic ascent ephemeris **equatorial** orbit escape ...
www.daviddarling.info/encyclopedia/ S/spaceflight_entries.html - 78k - Cached - Similar pages

[PDF] The calcium exosphere of Mercury
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... low Ca abundance is seen in the **equatorial** regions ... here were obtained at the Keck I **telescope** with HIRES ... where U is the binding energy (**Johnson**, 1990), then for ...
www.astro.umd.edu/~rkillen/ publication/ca_paper_rev2.pdf - Similar pages

ISEC 2001 Abstracts
... 77058; (2) Lockheed Martin-NASA **Johnson** Space Center ... higher latitudes, later in the **equatorial** region ... measurements of the Proton Electron **Telescope** (PET) onboard ...
landau.rice.edu/~aac/isec2001/abs.html - 88k - Cached - Similar pages

[PDF] was WV, In
File Format: PDF/Adobe Acrobat
... written and executed by Mr. Ralph M. **Johnson** of Hughes ... equal to the longitude in the **equatorial** system). ... In every case the **telescope** was first "peaked up" with ...
ieeexplore.ieee.org/iel6/ 8234/25592/01142142.pdf?arnumber=1142142 - Similar pages

NASA Dryden X-Press - April 1995
... has been collecting data on the **equatorial** region of ... Mission to Planet Earth and the Hubble Space **Telescope**. ... in the Astronaut Office at the **Johnson** Space Center ...
www.dfrc.nasa.gov/Newsroom/X-Press/1995/xp-95-04.html - 44k - Cached - Similar pages

[PDF] 7787 CIW Year Book Text
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... Shown as a single broad white **contour** is the ... southern hemi- spheres, including the biggest **telescope** in the ... **Equatorial** density after 2,200 years is shown for a ...
carnegieinstitution.org/YearbookPDF/DTM.pdf - Similar pages

[PDF] arXiv:astro-ph/0208172 v1 7 Aug 2002
File Format: PDF/Adobe Acrobat - View as HTML
... Since **Johnson** & Hogg (1965) reported the first three ... star and the formation of the **equatorial** ring in ... taken by Chris Smith with the Curtis Schmidt **telescope**. ...
arxiv.org/pdf/astro-ph/0208172 - Similar pages

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Suggestions:

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www.ing.iac.es/PR/AR1998/ann98lo.pdf - Similar pages

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Johnsonian Cool
... of the two largest commercial **telescope** manufacturer's, modern ... The **Johnsonian** is an attempt to innovate in a ... Development: With an **equatorial** tracking platform ....
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[PDF] Users Manual
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... **Equatorial** Platform Top 1 TYPE IV Top ... one of the main features why you purchased the **Johnsonian** tm ... 8. Line contact must be achieved with full **telescope** weight. ...
www.johnsonian.com/My_Homepage_Files/ Download/Users%20Manual_Type_IV.pdf - Similar pages

Geocrawler.com - atm - How can an ATM easily fabricate these EQ ...
... On the page: http://www.**johnsonian**.com/cool.htm ... The Theoretical Development: With an **equatorial** tracking platform ... which could change their **bearing** diameter as ...
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the of to a and is in I that you it for be are have not with on s ...
... sample Electronics income **Johnson** physically mechanics ... en mu Book spare **adjust** granted maintenance ... FILE heterosexual preserved **Equatorial** geological poisoning ...
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... Discovery missions (ie NEAR, **CONTOUR**, Deep Impact ... that cannot be mounted onto the **telescope**. ... and the distribution of hydrated (water-**bearing**) minerals (Klassen ...
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VENDELINUS ASTRONOMY NEWSLETTER ...
... But in **equatorial** regions, lightning appears more often during ... Los Alamos National Laboratory and at **Johnson** Space Center ... of time so your eyes can **adjust** to the ...
tbird5.astro.warwick.ac.uk/~erwin/ VND_newsletter/Txt/newsletter_2001_12.txt - 59k - Cached - Similar pages

Dr. Gilbert V. Levin's August 1997 SPIE Paper
... Exchange (GEx) experiment, it did not **adjust** the raw ... 54,55,56 established that midday **equatorial** temperatures rose ... Carle, FS Brown, and RD **Johnson**, "The Viking ...
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... Images: -Background: Horsehead Nebula (NASA) Left to right: -The 30 Doradus Nebula (NASA, Space **Telescope** Science Institute, La Plata Observatory) -Artist ...
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... addressed adelaide adfunk adipic **adjust** admin admiring ... episcopal episcopalians eponymous eq **equatorial** equine equipments ... jivha jocka joel **johnson** joined jokes ...
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Did you mean: latitude equatorial platform radii telescope bearing latitudes contour OR contours OR *contour* OR contouring

Johnsonian Cool
... The Theoretical Development: With an **equatorial** tracking **platform**, what ... **bearing** diameter as some function of **latitude** angle ... 1). Now one **platform** can work at all ...
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USIGS Definitions and Descriptions - L
... **latitude**, Angle from the **equatorial** plane to the ... and as a minimum consist of a hardware **platform** and an ... level; hand level; hanging level; **latitude** level; Lenoir ...
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... Island) stations continue to provide a **platform** for the ... The annual cosmic radiation **latitude** survey was conducted aboard the ... Cosmic Ray Surface Muon **Telescope** ...
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... See also AC- TIVE SATELLITE, EARTH SATELLITE, **EQUATORIAL** SATELLITE, GEODETIC ... of arc along the meridian at **latitude** 48 ... of a circle bounded by two **radii** and an arc ...
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> File Format: PDF/Adobe Acrobat - View as HTML
> ... of the waters of the Atlantic North **Equatorial** Current with ... The **platform** or station from which soundings are taken ... equal to or less than the **latitude** of the ...
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... determined through computation, by using **telescope** measurements of ... determine the difference in **radii** of curvature ... change but the geodetic **latitude** does change ...
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... before the natural pericentre drift to the southern **latitudes**. ... the UK's Jodrell Bank radio **telescope** nor by ... mounted directly on the lander **platform**: the Gas ...
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... 2 Minimum distance of the Moon's shadow axis from Earth's center in units of **equatorial** Earth **radii**. Page 10. 2 T OTAL S OLAR E CLIPSE OF 2002 D ECEMBER 04 ...
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[DOC] ROUND THE MOON
File Format: Microsoft Word 97 - View as HTML
... his time, while leaning over the gigantic **telescope** he watched ... of the earth, which under the **latitude** of Florida ... the moon, is equal to 56 terrestrial **radii**, say ...
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[DOC] Use this as master
File Format: Microsoft Word 97 - View as HTML
... in Florida, in 27° 7' North **latitude**, and 77 ... time, while leaning over the gigantic **telescope** he watched ... nothing now but a metal coffin, **bearing** three corpses ...
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... and 3.6m Advanced Electro-Optical System **telescope**. ... of solar activity and observations at high solar **latitudes**. ... of a Spherical Air-**Bearing** Spacecraft Simulator ...
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Johnsonian Cool
... The Theoretical Development: With an **equatorial** tracking **platform**, what ... **bearing** diameter as some function of **latitude** angle ... 1). Now one **platform** can work at all ...
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... **latitude**, Angle from the **equatorial** plane to the ... and as a minimum consist of a hardware **platform** and an ... level; hand level; hanging level; **latitude** level; Lenoir ...
www.fas.org/irp/agency/nima/nug/gloss_l.html - 101k - Cached - Similar pages

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... Generic Technology **Platform** (GTP), A term used to ... geodetic **latitude**, Angle from the **equatorial** plane to ... of lines representing parallels of **latitude** and meridians ...
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Indian Remote Sensing Satellite Cartosat-1: Technical features and ...
... 7. Local Time for **Equatorial** Crossing, 10:30 AM. ... precision Attitude Control System to provide a stable **platform**. ... For any given **latitude**, it can also be achieved ...
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... will continue to provide a **platform** for research ... and process ionosonde data at high **latitude** stations ... in the Australian region extending from **equatorial** to high ...
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Space and Astronomy News
... region reaching as far north as 50 deg S **latitude**. ... Endeavour is on the Mobile Launch **Platform**, mated to ... than did waves traveling along the **equatorial** plane, or ...
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... determined through computation, by using **telescope** measurements of ... change but the geodetic **latitude** does change ... change will change geodetic **latitudes** by less ...
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the of to a and is in I that you it for be are have not with on s ...
... publicly Secret blowing **platform** uncertainty directed ... lane Carrying skip **latitude** achievement Source ... heterosexual preserved **Equatorial** geological poisoning ...
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... andobservationsbythe amazing Hubble space **telescope** (HST), have ... The **equatorial** diameter of Mars is 6788km ... south- erly declination (celestial **latitude**) at such ...
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... position and orientation were established from astronomic observations of **latitude**, longitude and ... an angle closure error is detected the grid **bearing** of the ...
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... by the UK's Jodrell Bank radio **telescope** nor by ... The ground **segment** includes the new ESA station of New ... were mounted directly on the lander **platform**: the Gas ...
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... Moreover, a SAR interferometry-based technique for the combined segmentation of homogenous areas, **segment**-wise land-use ... The space **telescope** INTEGRAL and JEM ...
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... The Theoretical Development: With an **equatorial tracking platform**, what is ... figure 3 onto a small **bearing segment** (item 27 ... 1). Now one **platform** can work at all ...
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... determined through computation, by using **telescope** measurements of ... by a sparse network of **tracking** stations, and ... change will change geodetic **latitudes** by less ...
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> ... will continue to provide a **platform** for research ... This project is **bearing** good scientific return. ... in the Australian region extending from **equatorial** to high ...
> www.science.org.au/reports/cospar.pdf - Similar pages
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[PDF] GLOSSARY OF MARINE NAVIGATION
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... A satellite **tracking** system which operates by transmission of ... are generally recognized- (1) **equatorial** (E), the ... circle fitted with a **telescope** to facilitate ...
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the of to a and is in I that you it for be are have not with on s ...
... replies kilograms Back **tracking** Jersey Make ... publicly Secret blowing **platform** uncertainty directed ... FILE heterosexual preserved **Equatorial** geological poisoning ...
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Google equatorial platform segment telescope bearing Search Advanced Search Preferences

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Did you mean: equatorial platform segment telescope bearing block contour OR contours OR ***contour*** OR contouring

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... The Theoretical Development: With an **equatorial** tracking **platform** ... was never solved; thus, each **platform** had to ... of figure 3 onto a small **bearing segment** (item 27 ...
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USIGS Definitions and Descriptions - L
... latitude, Angle from the **equatorial** plane to the considered ... minimum consist of a hardware **platform** and an ... light in which the nonactive **segment** reflects incident ...
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the of to a and is in I that you it for be are have not with on s ...
... Humans publicly Secret blowing **platform** uncertainty directed ... FILE heterosexual preserved **Equatorial** geological poisoning ... Body wounded Bohr **Segment** ordeal MORSE ...
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....PB, Long-term variability in the **equatorial** middle atmosphere ... will continue to provide a **platform** for research ... This project is **bearing** good scientific return. ...
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... by the UK's Jodrell Bank radio **telescope** nor by ... The ground **segment** includes the new, ESA station of New ... were mounted directly on the lander **platform**: the Gas ...
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dobsonian AND poncet [Search]

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☐ **11.** CUAS - How to Choose a Scope
Oct 2004
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Aug 1998
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[http://www.tass-survey.org/richmond/answers/telescope....]
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☐ **13.** No Title
Apr 2003
...Activities: - Design, plan and built the 8" Fitzgerald **Dobsonian** Telescope - Design, plan and built the 8" Barney...and build an Equatorial Tracking platform for **Dobsonian** telescopes (a **Poncet** platform) - Design and build an number of type...
[http://www.path.queensu.ca/~kell/papers/kingstonmanual...]
similar results

☐ **14.** Amateur Telescopes FAQ Part II
Aug 1994
...built an 8" and a 12.5" reflector on **Dobsonian** mounts (of course). We went this way...course, complete details for making a **Dobsonian**. 169 pages 154 clear, friendly line drawings...shows how you can build your own low-cost **Dobsonian** Telescope. The 90-minute video is a complete...
[http://www.hcs.harvard.edu/~stahr/info/scope_faq_2.htm...]
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...1980:5:425 cross-axis in a box 1983:10:351 **Dobsonian**, equatorial tracking 1981:1:85 economical homemade...comet seeking 1978:7:73

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binocular
binoculars
celestial objects
collimation
eyepiece
eye relief
fiberglass
focal length
polar axis
radio telescope
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teflon
telescope makers

Or refine using:
All of the words
[refine]

Web

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Meade Instruments Corporation - Meade LX200 Instruction Manuals
... the tilt plate to be adjusted for **any latitude** greater than ... knobs are supplied for mounting the **telescope's** drive base to the tilt-plate of the **equatorial** wedge ...
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... the factory to allow the tilt plate to be adjusted for **any latitude** greater than ... Further details on **telescope** polar alignment see Appendix A: **Equatorial** Use ...
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... Motorizing a **dobsonian** adds automatic tracking and finding ... Adding an **equatorial** table is a good solution ... to build, no modification to the **telescope** itself is ...
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Motorize Your **Telescope** - Why Motorize a **Dobsonian Telescope**?
... Adding an **equatorial** table is a good solution ... Computerizing the **dobsonian** mount is the solution I choose ... after a quick alignment, the **telescope** accurately tracks ...
www.cdcc.sc.usp.br/cda/telescopios/ hp-mbartels/altaz/why.html - 8k - Cached - Similar pages

Megawedge Review
... company many amateurs turn to for **telescope** accessories is ... they can turn to for an **equatorial** wedge for ... the Megawedge is adjustable for **any latitude** on Earth ...
www.jimsmobile.com/html_docs/megawedge_review.htm - 7k - Cached - Similar pages

Nasmyth Focus Position Angle Tracking
... The correct usage of Parallactic Angle is in the context of the **Equatorial** and Ecliptic ... These definitions hold for any Alt-Az **telescope** at **any latitude**. ...
www.ucolick.org/~sla/deimos/swpdr/va.html - 9k - Cached - Similar pages

HISTORY
... The polar axis mounting can be adjusted to **any latitude** from 0 ... making the total cost of the **telescope** $975 ... This better **equatorial** would also be fitted to use on ...
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Equatrak Features
... which is a orientation where your **dobsonian** mount itself ... on Polaris - just like a real **equatorial** mount. ... proper tracking rates each time the **telescope** is moved ...
www.stardrivesystems.com/features.htm - 8k - Cached - Similar pages

BSS Glossary - A through Z
... of the sun, through a movable **telescope** or open ... at, or be adjusted for, **any latitude**. ... universal **equatorial** ring ~ (or - equinoctial -): a portable dial which ...
www.sundialsoc.org.uk/glossary/alpha.htm - 101k - Cached - Similar pages

Company Seven | Celestron Celestar 8 Deluxe Schmidt-Cassegrain ...
... tilt plate facilitates polar alignment at **any latitude** between 28 to ... caution not to tilt the **telescope** so far ... This **equatorial** wedge accepts an optional "Deluxe ...
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... 28 Appendix B: **Equatorial** Use ... keypad functions through, or write custom **telescope** software for ... sealed polar ball **bearing**, quartz-microprocessor-controlled 5.75 ...
www.meade.com/manuals/TelescopeManuals/ LXseries/LX200_Classic_Manual.pdf -
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... Note that the front radius **bearing** is fixed. ... performing materials best suited to **telescope** applications, heat ... will drive even the most unbalanced **Dobsonian**. ...
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Johnsonian FAQs
... If you own a **Dobsonian** type **telescope**, then you ... visual observing), and have the **telescope** placed on it ... design and fabrication of special **bearing** surfaces, these ...
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COSMIC RAYS VELOCITIES EXCEED CONSIDERABLY THE SPEED OF LIGHT (c)
... for **any latitude**, since the maximum (**equatorial**) tangential speed ... As it is known, the **telescope** will automatically ... the Rollers are of ball **bearing** type: Item 1 ...
www.jjhsamra.com.ar/ - 49k - Cached - Similar pages

[PDF] Meade Instruments Corporation - Meade LX200 Instruction Manuals
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... Appendix B: **Equatorial** Use ... sealed polar ball **bearing**, quartz-microprocessor-controlled 5.75" worm gears ... power cord and adapter for **telescope** operation from 115v ...
www.lethbridgeastronomysociety.ca/LX200-10.pdf - Similar pages

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... For convenience this distance is sometimes expressed in units of the **equatorial** radius of ... magnitude, the dimmest that can be seen through a 200-inch **telescope**. ...
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UNPh36.html
... If a **telescope** is used, make a sunshade for it ... is best hung indoors with the ball **bearing** resting on ... bulges at the equator such that the **equatorial** diameter is ...
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... arrow change the azimuth or compass **bearing** of the ... view through a very high-power **telescope** eyepiece ... more convenient to work in "**equatorial** coordinates" - right ...
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telescope bearing dobsonian OR equatorial (Search Advanced Search Preferences

Web Results **1** - **10** of about **38** for **telescope bearing dobsonian OR equatorial OR poncet "all latitudes"**. (**0.31** seconds)

Johnsonian Cool
... Note that the front radius **bearing** is fixed. ... performing materials best suited to **telescope** applications, heat ... will drive even the most unbalanced **Dobsonian**. ...
www.johnsonian.com/My_Homepage_Files/Page2.html - 15k - Cached - Similar pages

IAU 2000 - ABSTRACTS
... suggest an abundance of sulfur-**bearing** compounds such ... with ADONIS [1] at the ESO **telescope** (Chile), we ... The large **equatorial** area (probably connected with the ...
www.jb.man.ac.uk/~abstract/abstracts/JD12T.html - 29k - Cached - Similar pages

USCG General Navigation Questions: Master's License (QUESTION)
... course to port to rapidly open the **bearing** to the ... 147: Which statement is TRUE concerning **equatorial** tides ... horizon glass c. micrometer drum d. **telescope** 165: On ...
jule-iii.com/cgi-bin/uscg/ uscg.pl?Book=3&mode=All& - 101k - Cached - Similar pages

[PDF] Observations of Martian ice clouds by the Mars Global Surveyor ...
File Format: PDF/Adobe Acrobat - View as HTML
... of observations the trends for **all latitudes** for which ... et al., 1990] Hubble Space **Telescope** (HST) images ... L s 60) show well-developed **equatorial** clouds [James ...
www.mars.asu.edu/christensen/docs/pearl_clouds_jgr.pdf - Similar pages

[PDF] Chapter 2 A review of Mars dust observations
File Format: PDF/Adobe Acrobat - View as HTML
... and images taken by this **telescope** were used to ... the abundance and distribution of unknown water-**bearing** minerals on ... some **equatorial** regions in the range 60 £ W ...
www.gps.caltech.edu/~claire/thesis/ch2.pdf - Similar pages

[PDF] BK NBR ANS QUESTION CHOICE A CHOICE B CHOICE C CHOICE D ...
File Format: PDF/Adobe Acrobat - View as HTML
... 3 109 C While proceeding along the Norwegian coast on course 039°T, you sight the black-yellow-black banded buoy shown **bearing** 053°T. What action should you ...
www.uscg.mil/hq/g-m/marpers/examques/Book3-Oct04.pdf - Similar pages

[PDF] Astronomy Astrophysics
File Format: PDF/Adobe Acrobat
... bright points in full-disc EIT (the Extreme-Ultraviolet Imaging **Telescope** on board of ... 1b indicates a slower-than-average rotation in the **equatorial** regions (B ...
www.edpsciences.org/articles/aa/pdf/2003/24/aa3513.pdf - Similar pages

[PDF] By Peter M. Giles December 1999
File Format: PDF/Adobe Acrobat - View as HTML
... will have a **bearing** on our understanding of solar ... **telescope** in the rst decade of the seventeenth ... fact signicantly slower, compared to the **equatorial** rate, than ...
sun.stanford.edu/~giles/thesis/PDF/PMG_Dissertation.pdf - Similar pages

[PDF] AUGUST 2000 Post/8.24
File Format: PDF/Adobe Acrobat - View as HTML
... of ionospheric plasma structuring at **all latitudes** • The global ... on the Hubble Space **Telescope** to mark ... interests include the **equatorial** electrojet, auroral ...
cedarweb.hao.ucar.edu/commun/POST_40.pdf - Similar pages

[PDF] Jupiter's Thermosphere and Ionosphere
File Format: PDF/Adobe Acrobat - View as HTML
... obtained with the Hopkins Ultraviolet **Telescope** (HUT) on ... sim- ilar to that required for **equatorial** models, implying ... analysis that have a direct **bearing** on the ...
www.lpl.arizona.edu/~yelle/ homepage/eprints/Yelle04a.pdf - Similar pages

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Web Results **11** - **20** of about **38** for **telescope bearing dobsonian OR equatorial OR poncet "all latitudes"**. (0.10 seconds)

[PDF] The ESRI Press Dictionary of GIS Terminology
File Format: PDF/Adobe Acrobat
... direction. 2. The part of a theodolite containing the **telescope** and attachments. allocation ... named. B Page 12. barrier–**bearing** 9 barrier ...
www.evansvillegis.com/PDF/GIS_Dictionary.pdf - Similar pages

[PDF] cedarpost|fall 04.indd
File Format: PDF/Adobe Acrobat - View as HTML
... Dave Hysell of Cornell University ('AMISR Contributions to **Equatorial** Aeronomy'), and ... the signifi- cance of being able to determine the **bearing** of microme ...
cedarweb.hao.ucar.edu/community/POST_current.pdf - Similar pages

[DOC] Part-1
File Format: Microsoft Word 97 - View as HTML
... Therefore even in Martian **equatorial** regions (from -300 to ... observations with the Hubble **telescope** have provided ... with wadi-like riverbeds, **bearing** testimony to ...
www.iki.rssi.ru/MARSES/files/MARSES99-n.doc - Similar pages

[PDF] B RESEARCH
File Format: PDF/Adobe Acrobat - View as HTML
... in selected regions, particu- larly **equatorial**) surveys have ... obtained with the 1.0-m **telescope** at Sutherland. ... period- colour diagrams and their **bearing** on the ...
www.saao.ac.za/annual_reports/2000/SecB.pdf - Similar pages

[PDF] SOUTH AFRICAN
File Format: PDF/Adobe Acrobat - View as HTML
... and A Fairall (UCT) have had two 1.0- m **telescope** observing runs to ... DEEP" (increased sensitivity in selected regions, particu- larly **equatorial**) surveys have ...
www.saao.ac.za/annual_reports/2000/2000.pdf - Similar pages

The Project Gutenberg EBook of Vestiges of the Natural History of ...
... which they present to our vision through the **telescope**. ... This bulging makes the **equatorial** exceed the polar ... plants of vascular tissue, and **bearing** flowers, in ...
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[PDF] TOURING THE SATURNIAN SYSTEM: THE ATMOSPHERES OF TITAN AND SATURN ...
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... dis- tributions of trace hydrocarbons, nitriles and oxygen **bearing** compounds in ... Subsequent studies with the Hubble Space **Telescope** and ground-based adaptive ...
www.kluweronline.com/article.asp?PIPS=5106932&PDF=1 - Similar pages

[PDF] ARS XPRESS
File Format: PDF/Adobe Acrobat - View as HTML
... The fate of Beagle 2 remains unknown because no signal was ever received from the martian surface, neither by the UK's Jodrell Bank radio **telescope** nor by ...
www.esa.int/esapub/sp/sp1240/sp1240web.pdf - Similar pages

[PDF] AAS/AIAA Astrodynamics Specialist Conference PROGRAM
File Format: PDF/Adobe Acrobat - View as HTML
... 5 99-311 Elliptical Sun-Synchronous Orbits with Line of Apsides Lying In or Near the **Equatorial** 0930am Plane –JE Draim, PJ Cefola, RJ Proulx, DR Larsen, GR ...
www.space-flight.org/AAS_meetings/ 1999_astro/1999_astro_program.pdf - Similar pages

[PDF] Solar Power Satellites (Part 5 of 18)
File Format: PDF/Adobe Acrobat - View as HTML
Page 1. Chapter 3 ISSUES AND FINDINGS Page 2. Contents Page Technical Options .. ... 23 Microwave Transmission ....
www.wws.princeton.edu/cgi-bin/ byteserv.prl/~ota/disk3/1981/8124/812405.PDF - Similar pages

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telescope bearing dobsonian OR e Search

Web Results **21** - **30** of about **38** for **telescope bearing dobsonian OR equatorial OR poncet "all latitudes"**. (6.29 seconds)

[PDF] Glory of The Stars
File Format: PDF/Adobe Acrobat - View as HTML
... There are 60 small motors in the installation; yet so perfectly is the **telescope** mounted on its **bearing** (which, by the way, is 45 feet in diameter) that it ...
www.maranathamedia.com.au/Download/ Books/The%20Glory%20of%20the%20Stars.pdf - Similar pages

[PDF] ASCENSION .
File Format: PDF/Adobe Acrobat - View as HTML
Page 1. SIX MONTHS IN ASCENSION . Page 2. Page 3. SIX MONTHS IN ASCENSION An Unscientific Account of a Scientific Expedition. B Y MRS. GILL. WITH A MAP. LONDON ...
www.bweaver.nom.sh/gill/gill.pdf - Similar pages

[PS] Evolution of the SL9 Impact Sites and Numerical Experimentswith a ...
File Format: Adobe PostScript - View as Text
... absolute reflectivity (I/F) spectrum of Jupiter for **all latitudes**. ... Array (VLA) and the Australia **Telescope** (AT ... at the position of the North **Equatorial** Belt (NEB ...
www.stsci.edu/ftp/meetings/ jupiter-impact/poster_abstracts.ps - Similar pages

[PS] The Lunar Atmosphere: History, Status, Current Problems, and ...
File Format: Adobe PostScript - View as Text
... reported using the Hubble Space **Telescope's** [HST's) Faint ... The surface reduction of oxygen-**bearing** minerals via ... it far stronger in **equatorial** latitudes than ...
www.boulder.swri.edu/~alan/papers/rev.ps - Similar pages

[PDF] The Toilers of The Sea
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Page 1. The Toilers of The Sea Victor Hugo May 11, 2004
Page 2. 2 Page 3. Contents Preface . . . .
books.rakeshv.org/pdf/toilers.pdf - Similar pages

> [PS] The Toilers of The Sea
> File Format: Adobe PostScript - View as Text
> The Toilers of The Sea Victor Hugo May 11, 2004 2 Contents Preface . . . .
> books.rakeshv.org/ps/toilers.ps - Similar pages

[DOC] INTERNATIONAL BIBLIOGRAPHY OF GNOMONICA
File Format: Microsoft Word 97 - View as HTML
INDEX. BOOK ONE: A Bibliography of Gnomonica : from 300 to around 11.500 titles (N. Severino) pag. 4. An Opusculum of dialling references (CK Aked) 7. ...
www.meridianeitaliane.it/Libri/ International%20Bibliography%20of%20Gnomonica.doc - Similar pages

Untitled
... EIT (the Extreme-Ultraviolet Imaging **Telescope** on board ... On the other hand, in the **equatorial** region ( ), corresponding ... **Bearing** this in mind one can put forward ...
aanda.u-strasbg.fr:2002/articles/ aa/full/2003/24/aa3513/aa3513.right.html - 101k - Supplemental Result - Cached - Similar pages

[PDF] QUESTIONS NAVI & ASTRO
File Format: PDF/Adobe Acrobat - View as HTML
... 132 B The value of sixty nautical miles per degree of geodetic latitude is most correct at _____. the equator latitude 45° the poles **all latitudes** ...
infomar-bg.org/modules.php?name=Web_ Linkz&l_op=visit&lid=57 - Supplemental Result - Similar pages

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... direction. 2 . The part of a theodolite containing the **telescope** and attachments. allocation ... named. B Page 12. barrier–**bearing** 9 barrier ...
www.bae.uky.edu/gis/BAE599_003/ Resources/Readings/GIS_Dictionary.pdf - Supplemental Result - Similar pages

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dobsonian OR equatorial OR poncet "contour | Search | Advanced Search Preferences

Web

Tip: Try removing quotes from your search to get more results.

Your search - **dobsonian OR equatorial OR poncet "contoured bearing"** - did not match any documents.

Suggestions:

- Make sure all words are spelled correctly.
- Try different keywords.
- Try more general keywords.
- Try fewer keywords.

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Web Results **11** - **17** of about **22** for **telescope bearing dobsonian OR equatorial OR poncet "any latitude"**. (**0.16** seconds)

Phys. Rev. 90, 934 (1953): Simpson et al. - Cosmic Radiation ...
... particle momenta greater than the **equatorial** geomagnetic cutoff ... of intensity variations will have a **bearing** on the ... chamber or vertical counter **telescope** with no ...
link.aps.org/doi/10.1103/PhysRev.90.934 - Similar pages

[PDF] ARE THE PLANETSINHABITED?
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... Has this fact any theological **bearing**? ... its edge fairly well-defined both as seen in the **telescope** and as ... while the **equatorial** belt in general gives a period sm....
home.att.net/~l.caimi/Mprint-F.PDF - Similar pages

[PDF] ARE THE PLANETS INHABITED
File Format: PDF/Adobe Acrobat - View as HTML
.... Author of "Astronomy Without a **Telescope**" The Royal Observatory, Greenwich, Its History and Work" ETC ... Has this fact any theological **bearing**? ...
home.att.net/~p.caimi/PLANETS.pdf - Similar pages
[More results from home.att.net]

[PDF] cedarpost|fall 04.indd
File Format: PDF/Adobe Acrobat - View as HTML
... Dave Hysell of Cornell University ('AMISR Contributions to **Equatorial** Aeronomy'), and ... the signifi- cance of being able to determine the **bearing** of microme ...
cedarweb.hao.ucar.edu/community/POST_current.pdf - Similar pages

Geocrawler.com - atm - EQ Platform Idea (Was: How can an ATM ...
... motion necessary for an EQ platform, adjustable for **any latitude**. ... A new design of **equatorial** platform is ... http://www.johnsonian.com/ > > The **bearing** shape is a ...
www.geocrawler.com/archives/3/99/2001/9/450/6649811/ - 15k - Supplemental Result - Cached - Similar pages

UNPh36.html
... (a) If a **telescope** is used ... It is best hung indoors with the ball **bearing** resting on a stout ... The Earth bulges at the equator such that the **equatorial** diameter is ...
www.kpbsd.k12.ak.us/alaskaonline/pt%20Web/ Academic%20Interests/Science/UNESCO/UNESCO%20Resources/UNPh36.html - 88k - Supplemental Result - Cached - Similar pages

[PDF] PROPOSAL INFORMATION PACKAGE
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... to deliver two mobile science vehicles to different sites in the **equatorial** region of Mars. ... Determine the relative abundances of the iron **bearing** phases in ...
merpip.jpl.nasa.gov/MER-PIP.pdf - Supplemental Result - Similar pages

In order to show you the most relevant results, we have omitted some entries very similar to the 17 already displayed. If you like, you can repeat the search with the omitted results included.

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Google dobsonian equatorial latitudes OR latitude Search Advanced Search Preferences

Web Results **1** - **10** of about **824** for **dobsonian equatorial latitudes OR latitude**. (**0.69** seconds)

Product search results for **dobsonian equatorial latitudes OR latitude**

Meade Starfinder 16" f/4.5 **equatorial** - $2,995.00 - astronomics

The 10" **Dobsonian Equatorial** Telescope
The 10" **Dobsonian Equatorial** Telescope. ... I have seen ads for **Equatorial** Platforms and considered ... the platforms are taylor made for your approximate **latitude**. ...
uplink.space.com/printthread.php?Cat=& Board=askastronomer&main=60001&type=post - 5k - Cached - Similar pages

The 10" **Dobsonian Equatorial** Telescope - Forums powered by ...
... The 10" **Dobsonian Equatorial** Telescope, ... I have seen ads for **Equatorial** Platforms and considered ... the platforms are taylor made for your approximate **latitude**. ...
uplink.space.com/showflat.php?Cat=&Board=askastronomer& Number=60001&page=19&view=collapse... - 35k - Cached - Similar pages
[More results from uplink.space.com]

This article describes a new **equatorial** table design for **Dobsonian** ...
... I needed a table for my 17.5" **Dobsonian**, but the ... However, for other **latitudes**, the two triangles have to be of ... telescope and moving part of the **equatorial** table ...
home.webuniverse.net/raethrasher/eqmount.htm - 13k - Cached - Similar pages

The_Equatorial_Platform
... If the **Dobsonian** principle is to be retained, two systems are ... This system is known as an **Equatorial** Platform. ... its position on the Earth ie the **latitude** of the ...
homepage.ntlworld.com/ molyned/the_**equatorial**_platform.htm - 26k - Cached - Similar pages

Willie's 9" Split-ring **Equatorial** Telescope
... **Dobsonian** drive options were either an **equatorial** table or a dual axis computer controlled drive. An **equatorial** table for 33° **latitude** has its problems and my ...
www.saao.ac.za/~wpk/scope/scope.html - 8k - Cached - Similar pages

Equatorial Platforms - Dobsonians on Platforms
... to account for the 5 degree **latitude** change from ... 15" Obsession on a Dual-axis **Equatorial** Platform, A ... a 13" Cassegrain optical system mounted **Dobsonian** style and ...
astronomy-mall.com/regular/products/ eq_platforms/**dobsonians**.on.platforms.html - 9k - Cached - Similar pages

Equatorial Platforms - About Our Platforms
... the standard star-drift method, as with any **equatorial** mount. ... it can be used at other **latitudes** by simply ... 4) Now place your **Dobsonian** telescope on the Platform ...
astronomy-mall.com/regular/products/ eq_platforms/about.our.platforms.html - 18k - Cached - Similar pages
[More results from astronomy-mall.com]

Art nr
... Center Tripod Leg for High **Latitudes** (44°-66°) only for ETX-90RA. ... STARFINDER **Equatorial** 16, 16" f/4.5; 2" focuser, 8 x 50mm V/F ... Starfinder **Dobsonian** Telescopes. ...
www.astroteknik.nu/Meade/prislista.htm - 101k - Cached - Similar pages

Equatrak Features
... Most **equatorial** platforms are custom manufactured to work at your particular **latitude**. ... limits, which is a orientation where your **dobsonian** mount itself ...
www.stardrivesystems.com/features.htm - 8k - Cached - Similar pages

New Page 0
... It can only be used within 1° north or south of the **latitude** it was designed for. ... BACK. **Dobsonian** Telescope **Equatorial** Platform Tracker. ...
www.rylesprocket.com/MiscPics/EQ_Platform.htm - 12k - Cached - Similar pages

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	with **at least one** of the words	latitudes latitude	
	without the words		
Language	Return pages written in	any language	
File Format	Only return results of the file format	any format	
Date	Return web pages updated in the	anytime	
Occurrences	Return results where my terms occur	anywhere in the page	
Domain	Only return results from the site or domain	*e.g. google.com, .org More info*	
SafeSearch	◉ No filtering ○ Filter using SafeSearch		

Froogle Product Search (BETA)

Products	Find products for sale	Search To browse for products, start at the Froogle home page

Page-Specific Search

Similar	Find pages similar to the page	Search *e.g. www.google.com/help.html*
Links	Find pages that link to the page	Search

Topic-Specific Searches

New! Local - Find local businesses and services on the web.

Apple Macintosh - Search for all things Mac
BSD Unix - Search web pages about the BSD operating system
Linux - Search all penguin-friendly pages
Microsoft - Search Microsoft-related pages

U.S. Government - Search all .gov and .mil sites
Universities: Stanford, Brown, BYU, & more - Narrow your search to a specific school's website

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SYSTEM:OS - DIALOG OneSearch
  File   2:INSPEC 1969-2005/Mar W1
         (c) 2005 Institution of Electrical Engineers
  File  47:Gale Group Magazine DB(TM) 1959-2005/Mar 18
         (c) 2005 The Gale group
  File  88:Gale Group Business A.R.T.S. 1976-2005/Mar 16
         (c) 2005 The Gale Group
  File 103:Energy SciTec 1974-2005/Mar B1
         (c) 2005 Contains copyrighted material
*File 103: For access restrictions see Help Restrict.
  File 111:TGG Natl.Newspaper Index(SM) 1979-2005/Mar 17
         (c) 2005 The Gale Group
  File 141:Readers Guide 1983-2005/Dec
         (c) 2005 The HW Wilson Co
  File 484:Periodical Abs Plustext 1986-2005/Mar W2
         (c) 2005 ProQuest
*File 484: SELECT IMAGE AVAILABILITY FOR PROQUEST FILES
ENTER 'HELP PROQUEST' FOR MORE
  File 144:Pascal 1973-2005/Mar W1
         (c) 2005 INIST/CNRS


Set     Items   Description
S1          3   EQUATORIAL()DOBSONIAN?/TI
S2        134   DOBSONIAN/TI
S3          3   S2 AND EASIER/TI
S4        530   (DOBSONIAN OR PONCET) AND (SUBMOUNT???? OR MOUNT????? OR B-
             EARING???)
S5        178   S4 AND (TRACK???????? OR PLATFORM???????)
S6         76   S4 AND LATITUD?
S7        193   S4 AND EQUATOR???????
S8         34   4AND5AND6AND7
S9         18   RD S8 (unique items)
S10        24   S6 AND BEARING??
S11         3   S10 AND HING??????
S12        21   S10 AND S7:S9
S13        24   S10:S12
S14        10   RD S13 (unique items)
S15         3   S14 NOT  S9
S16         3   S14 NOT S9
```

Re: ATM Equilatorial or Poncet Platform for Dobsonian...

- *To*: bergrd@valunet.com (Richard T. Berg), atm@shore.net
- *Subject*: Re: ATM Equilatorial or Poncet Platform for Dobsonian...
- *From*: cshaw@ghgcorp.com (Chuck Shaw)
- *Date*: Mon, 2 Dec 1996 08:41:14 -0600
- *Reply-To*: cshaw@ghgcorp.com (Chuck Shaw)
- *Sender*: owner-atm@shore.net

Richard,

I had the pleasure of providing the plans for the equitorial platform to Matt for the ATM Page (tiac.net), and would enjoy coaching you through building one if you want to give it a go.

I think you will find that the very simple tangent arm drive, cylindrical bearing design is actually pretty easy to build, and gives surprisingly good results. Visually, its way more than adequate, and photographically it supports shorter exposure unguided shots (especially with a ccd camera and the short individual exposures they require.)

All together I know of about 30 folks that have built various versions of this design. We have about 10 of them in the Houston Area alone.

Access to a table saw will be handy, especially for cutting the angle for the blocks that support the sectors; and for making the platform upper and lower boards look nice. A metal cutting bandsaw will sure cut down on the labor for cutting out the sectors, but a hacksaw will most certainly work. If you have a router, you can make the sectors from hardwood and not worry about ANY metal working!

You HAVE to have an electric drill....... (for drilling holes and then for the grinding of the sectors.) Something like a workmate is required for holding the drill steady during the grinding process, or a router if you make them from wood.

Sounds like a lot of work, but its really not bad! Especially if more than one of you build them together. And you really do get lazy having an object stay in a high power eyepiece FOV for up to an hour at a time!!!

Have fun!

Chuck

Chuck Shaw
cshaw@ghgcorp.com (home e-mail)
cshaw@gp801.jsc.nasa.gov (work e-mail)
http://www.ghgcorp.com/cshaw (rudimentry homepage effort)

- Prev by Author: **ATM Re: Ground boards**
- Next by Author: **Re: ATM Dob focusers**
- Prev by thread: **ATM Equilatorial or Poncet Platform for Dobsonian...**
- Next by thread: **ATM Everest zones for TEX**
- Index(es):
  - **Author**
  - **Thread**

ATM Re: Equatorial Platform

- *To*: Jim Dear <jdear@mail.bayou.com>
- *Subject*: ATM Re: Equatorial Platform
- *From*: cshaw@ghgcorp.com (Chuck Shaw)
- *Date*: Mon, 11 Dec 1995 23:23:24 -0600
- *Cc*: ATM@shore.net
- *Reply-To*: cshaw@ghgcorp.com (Chuck Shaw)
- *Sender*: owner-atm@shore.net

Jim,

Your design should work fine. However, there are a couple of points you should consider:

If you use a single point for the northern pivot (no matter if you use the rather clever concept you described with the short shaft ot a ball socket mount), the polar axis will have to go through that pivot point. This will have the effect of having the "virtual" polar axis below the top board of the platform. This, in turn, guarantees that the CG of the scope will be ABOVE the polar axis. This will make the system behave a bit "top heavy" near the ends of the travel. It will have the effect of making the drive system have to work harder at these points, and if too extreme, can cause the scope to become unstable....

The "concave" arc will also work fine (this is the design that Al uses under his 17.5"/f4.5). The problem is that it requires that the polar axis goes DOWNWARD from the pivot point on the northern end. (see the preceeding comments on the single pivot point.)

So, I suggest thinking about a design that keeps the scope's cg as close to the "virtual" polar axis as possible.

This will require two sectors (north and south) but they are really quite easy to make very accurately with nothing more than an electric drill and a metal sanding disk (with the drill held in something like a workmate). The plans I put together show how to build the jig (a very simple thing to attach to the platform) to grind the sectors smooth and round. The accuracy achievable with such a crude setup is astounding. Al used my scope (14.5/f5) and platform to get a one minute UNGUIDED exposure (Prime focus) with his cookbook 245 ccd camera.....

The two sectors are really just the "bottoms" of sections of cylinders that revolve on the "virtual" polar axis. The southern cylinder section is a smaller diameter than the northern one. The drive (say a tangent arm) is attached to the northern edge of the platform (or a worm/contoured sector can be attached that has its center on the virtual polar axis, or, as I just modified one of my platforms to do, I simply turn the rollers that the platform rests on [this has the added benefit of eliminating the slight tangent error when away from the center of the sector]).

To answer your questions about availabilty of the plans, yes, I can send them to you as an e-mail attachment, or you will be able to FTP them from my internet provider at ftp/ghgcorp.com/cshaw as an MSMail file named "Platform.doc" as soon as my internet provider gets my FTP account set up.......(today or tomorrow I hope!!!)

Have I helped you or confused you?

Chuck Shaw

>Al Kelly, referred me to you regarding the design of an equatorial
>platform: I have a design in mind but he said that yours worked
>very well and I am interested in seeing it. Are drawings and/or a

```
>description available via internet?  I can use dxf/skd/wmf vector
>formats as well as most all bitmap formats.
>
>If you have time, I have a couple questions regarding my design:
>
>1.  For the northern pivoting point I plan to angle a short piece of
>shaft at an angle very near my latitude.  This shaft will be anchored
>in a bearing surface (probably a simple roller bearing).  I felt this
>would be more accurate that a pivoting point that must be flexible
>in 2 dimensions.  (This shaft should be equivalent to a polar axis)
>
>2.  On the southern end my plans call for an accurately cut
>concave arc to be driven by a stepper motor.  The way I see
>it, this arc must also be angled, in respect to vertical, at the
>same angle and the shaft, in a northern direction.
>(This arc should be aligned to the equatorial plane)
>
>3.  The accuracy of the platform is defined by how accurate the
>arc is cut and how well the arc and shaft are aligned to be
>perpendicular.
>
>My questions are:
>
>1.  Is my design idea proper in theory.
>2.  Do you have a suggestion on how to better design the
>northern pivoting point.
>3.  Am I correct in assuming that if I DO replace the shaft
>on the northern end with, maybe a balljoint of some sort,
>that it will lessen or eliminate the required accuracy in
>aligning the shaft and arc to be perpendicular.
>(I think I can visualize this)
>
>Thanks for any reply. And any assistance is greatly appreciated.
>
>Jim Dear
>jdear@mail.bayou.com
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- Prev by Author: **Re: ATM poncet**
- Next by Author: **Re: ATM Where to put the 3 teflon pads on rocker box base?**
- Prev by thread: **ATM RE: Elgin Grinding/Polishing Machine□Re: Elgin grinding machine (ATM)**
- Next by thread: **ATM Re: hot mirrors**
- Index(es):
    - **Author**
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SV: ATM re:Eq. platforms

- *To*: "Howard Banich" <Howard.Banich@nike.com>, <atm@shore.net>
- *Subject*: SV: ATM re:Eq. platforms
- *From*: "Nils Olof Carlin" <nilsolof.carlin@swipnet.se>
- *Date*: Tue, 7 Jul 1998 06:54:34 +0200
- *Reply-To*: "Nils Olof Carlin" <nilsolof.carlin@swipnet.se>
- *Sender*: owner-atm@shore.net

Howard,

> ps - hey list, doesn't ANY one else out there have a platform?

I built my first version and got it running a year ago.

To match the simplicity of a Dob would be hard indeed, but I'd say for visual use, it needn't be very much more difficult to make - it does need a motor and drive
electrics/electronics.
A late version for a 30 lbs 10" Dob weighs about 6 lbs, this includes about 2 lbs of 6 "D" cells! It is triangular, with largest dimension about 15", and a total height of 4" which is not very much more than the ground board it replaces. Here I used a Poncet approach, with a small ball joint and 2 pieces of Teflon sliding on Formica (designed for 60 deg N!!) for movement - this bit is indeed simpler than even a Dobsonian mount.
For driving it, I use a threaded rod driven by a stepper motor from a 5 1/4" disk drive, with a simple 555/SAAA1027 circuit (similar circuits can be found on the net). After 1 hr of tracking, it takes 2 minutes to automatically reset itself.

Admittedly my design is not for photo, but it is fine for visual use - very few Dobs are designed for photo anyway.
The platform has its limitations, but I think it deserves to be made by many more of us. And I too believe photo accuracy is obtainable if you try a little harder (I haven't yet - but I suspect I don't have the mentality of a true astro-photographer anyway ;-)

Nils Olof

- Prev by Author: **SV: ATM Bubble trouble - final follow up**
- Next by Author: **Re: ATM EQ Platform stability (was: Meade DS-16 mount)**
- Prev by thread: **re:Re: ATM re:Eq. platforms**
- Next by thread: **re:SV: ATM re:Eq. platforms**
- Index(es):
  - **Author**
  - **Thread**

Purchasing Amateur Telescopes FAQ

Slc.Dennis Bishop
starlord@ptw.com
Last Updated: 9807.22

Translated into HTML by Michael Richmond

This FAQ is under construction There may be some sections that are not totally done yet.

Questions in this FAQ:

Contributors to this posting include:

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Pierre Asselin  Dana Bunner     Doug Caprette
Mike Collins    Kevin Deane     Jay Freeman
Chuck Grant     Dyer Lytle      Christopher Gunn
Doug McDonald   Andy Michael    Dave Nash
Jim Van Nuland  Bill Nelson     Leigh Palmer
Alan Peterman   Tom Randolph    David Smith
Geoff Steer     Mario Wolczko   C. Taylor Sutherland
Paul Zander     David Knisely
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1. What is the single most important thing I should know before buying a telescope?

This is the single most important thing you should get out of this FAQ: DO NOT BUY YOUR TELESCOPE FROM A DEPARTMENT STORE.Ignore everything any literature tells you about magnification and such. Buy from a telescope store, where you will get a telescope that makes smaller claims, but will give you FAR better performance.

The reason is that as far as telescopes go, how much you can magnify is a function of the amount of light the telescope receives, which is almost entirely determined by the telescope's aperture (the size of the lens or mirror that points at the sky). As far as magnification goes, you can expect 50x per inch of aperture on a normal night.

Department stores always show little 2 1/4 inch refractors from 125+ dollars and say that the refractor can get up to a whopping 600x or so. Strictly speaking, this is true. However,applying the 50x rule, it is easy to see that 125x would be pushing the optics, and that is assuming that they were high quality ones. With the quality of the parts they usually give you are lucky to get 100x with reasonable resolution.

Recommendations for Beginning Amateur Astronomers

Jay Freeman
freeman@netcom.com

Occasionally, amateur astronomers ask for recommendations about telescope buying, learning the sky, and so on. Here are some thoughts.

(Let me state credentials. I am primarily a visual observer: Over 40 years I have logged about 6000 observations of nearly 3000 objects, and used perhaps thirty telescopes and binoculars enough to know them well. I have made roughly ten optical surfaces to 16-inch diameter (a sphere -- my biggest paraboloid was 8 inches). My forte is deep-sky work; observations I am proud to include the Sculptor Dwarf Galaxy (10x70 binocular), Maffei I and Leo II (Celestron 14), and S147 (6-inch Maksutov). My interests led to a physics PhD, studying the interstellar medium from a spacecraft: By training I am an astrophysicist, but I maintain amateur status in visual wavelengths -- my thesis work was in extreme ultraviolet.)

What to do First.

First, some meta-advice. Written words do not substitute for experience. Join an astronomy club, go to observing sessions, and try other peoples' telescopes. You will learn a lot, and will find people who like to discuss equipment and observing.

To find clubs, ask at science stores, museums, planetariums, and the like. Physics and astronomy departments of colleges may know, though clubs aren't strictly their line. Two popular astronomy magazines, *Astronomy* and *Sky & Telescope*, publish annual directories of clubs, stores, observatories, and such. Look for them on newsstands, or go to a library and read back issues, or try their web pages.

Been to a club already? Honest? Okay, you can keep reading...

Some Basic Questions.

In buying a telescope, you face bewildering, expensive choices. To help deal with the confusion, here are some questions to ask yourself.

1. How much effort are you willing to put into learning the sky? If you know the constellations, and have practiced finding things by "star-hopping" -- using charts instead of dial-in or punch-in coordinates -- you will be able to use a telescope cheaper, smaller, lighter, and easier to set up than one using precise alignment or computer control to locate objects.

2. How much effort are you willing to spend on your observing skills? Seeing fine detail in celestial objects, or just seeing faint ones at all, requires practice and special knowledge. Yet the rewards are enormous: An experienced observer may see things with a small telescope that a beginner will miss with one five times larger, even with objects and sky conditions that favor both telescopes equally.

3. How far will you have to lug your telescope to get it from where you keep it to where you use it, by what means, and how much effort will you put up with to do so? Differences in size and optical design create vast differences in telescope portability, and any telescope that you take out and use will be far better than one that sits in the closet because it is too heavy or too cumbersome.

4. Some people are into technology for its own sake, without regard to whether it is useful or cost effective. Are you willing to pay extra for sophisticated features, even if you don't need them? If so, fine -- lots of us like neat equipment. But if not, take care technology enthusiasts don't sell you things you don't need.

5. Do you want to take photographs or CCD images of celestial objects? "Astrophotography" is an expensive word. I am not into this side of the hobby, but friends who are typically take several telescopes and several years before they are satisfied, and spend lots more money than visual observers do.

Some Realities.

With these thoughts in mind, I can make some general comments.

- (A) The most important thing in determining the optical performance of a telescope is the diameter of the beam of light that goes into it -- its "clear aperture". Obviously, the more light, the fainter the things you can see, but less obviously, image detail is limited by clear aperture, via physical optics. Bigger telescopes produce sharper images, just because they are bigger.

  There are important qualifiers. First, bad craftsmanship can make any telescope perform poorly. Cheesy optics won't work. Fortunately, it is not too hard to make optics of the sizes and types common in amateur telescopes: most manufacturers routinely turn out units that are okay. Bad ones turn up, but major manufacturers will often fix or replace a real lemon, if you have wit to recognize that you have one, and will to complain. (Most of us have neither; that's how some manufacturers make money!)

  Second, different optical designs perform differently. Schmidt- Cassegrains, Newtonian reflectors, and refractors all have good and bad points. People who love telescopes, or sell them, will be eager to debate the matter. However, variations are relatively minor. It is usually adequate to assume all telescopes of given clear aperture and given quality of optical craftsmanship have the same optical performance: Real differences will correspond to changes in aperture of usually no more than 10 to 20 percent. Shabby optical work will increase that percentage enormously.

  Third, atmospheric turbulence ("seeing") limits the ability of a telescope to show detail, and sky brightness limits its ability to show faint objects. Poor seeing usually hits large telescopes harder than small ones. When seeing is poor, there may be no reason to take out and set up a big telescope. If you always observe from such conditions, you may have no reason to buy a big telescope. Yet, even in bright sky, a large-aperture telescope will show fainter stuff than a small one. And many of us have found dark-sky stable-seeing sites within a reasonable drive of home -- from sites near San Francisco Bay, sometimes I have to stare through the eyepiece of my Celestron 14 for several minutes before I can tell that there is any air between me and what I am looking at.

Notwithstanding these caveats, APERTURE WINS, and wins big. If you buy the finest 90 mm fluorite refractor in the world, do not be chagrined if a junior high school student shows up with a home-made 6-inch Newtonian that blows it clean out of the water: The 6-inch I made at 13 puts my world-class 90 mm fluorite to shame. There is no contest, and it's not because I was a master optician at 13, it is because six inches is bigger than 90 mm, hence intrinsically better.

- (B) Hundreds of deep-sky objects are big and bright enough to show well through apertures of two inches or so, at low magnifications. Thus, medium sized binoculars -- 7x50 or 10x50, say ("7x50" means "7 power, 50-mm aperture") make inexpensive, highly portable, easily operated beginner instruments. Perhaps you have one already. To use them well, you must be willing to learn the sky enough to find things with a hand-held instrument. And don't get one that gets too heavy to hold steady before you are done observing.

- (C) Speaking broadly:
  - (C.1) The most optical performance per unit of clear aperture comes from modern, high-quality refractors -- but they are outrageously expensive compared to other designs of the same aperture. Also, in sizes much above four-inch aperture, the tubes are generally long enough to make the whole instrument cumbersome and heavy.
  - (C.2) The most optical performance per unit of portability comes from Schmidt-Cassegrain and Maksutov designs -- but they are still pretty expensive. There's a qualifier here: What makes them portable are short, stubby tubes, but for small apertures -- say, four inches or less -- portability of all types is dominated by clumsiness of the tripod, so the portability advantage of Schmidt- Cassegrains and Maksutovs diminishes.
  - (C.3) The most optical performance per unit of cost comes from Newtonians -- particularly those with Dobson mountings. Compared to other telescopes of the same aperture, they are clumsier than Schmidt-Cassegrains and Maksutovs, but not nearly as clumsy as refractors.

  Let me regroup that information into three questions telescope buyers often ask:

  - (C.1') What gives most optical performance for a given aperture?

    Usually, a high-quality refractor.

  - (C.2') What gives most optical performance for a given car to carry it?

    Usually, a Schmidt-Cassegrain.

  - (C.3') What gives most optical performance for a given budget?

    Usually, a big Dobson.

- (D) Though costly and cumbersome, small refractors are durable and difficult to get out of whack. Good ones make respectable beginner instruments, particularly for beginners with extra thumbs. And a good small refractor provides a wonderful way for an experienced observer to embarrass folks with humungeous Newtonians who lack observing skills to exploit them. But BEWARE of mass-marketed junk refractors, advertised as high-power and sold in department stores.

- (E) Altazimuth mountings tend to be cheaper, lighter, less clumsy, and more quickly set up than equatorial ones, but to use one you must be willing to learn the sky well enough to find things without dialing in celestial coordinates. (Computer-controlled altazimuth mounts allow use of celestial coordinates to find things, or perhaps will look up the coordinates for you, in an internal data base, but they are not cheap.)

- (F) There's another way to look at this material. There are variety of ecological niches for telescopes, corresponding to different uses and requirements. I know of seven:

  - (F.1) Big Iron: This is the giant Dobson-mounted Newtonian, or humungeous Schmidt-Cassegrain, that fills your garage. To transport it requires a small trailer, pickup truck, or panel van, and setting it up calls for the concerted efforts of three used fullbacks and a circus elephant. The ladder to climb to the eyepiece is so tall you need supplemental oxygen to deter altitude sickness. This telescope is your galaxy-gazer and cluster-buster supreme, and if it is well made, then when the seeing is good it will show detail that those condescending high-tech dweebs with their confounded itty-bitty seven-inch apochromatic refractors can only dream about.

    My "Big Iron" is a Celestron 14, with a little tiny single-axle cargo trailer to haul it.

  - (F.2) Largest Conveniently Portable Telescope: This is the most telescope that will fit easily in your regular vehicle without hiring a bulldozer to clean it out. What it is, depends on what your vehicle is -- with a ten-speed, or a subway train, you have a problem. An eight- to eleven-inch Schmidt-Cassegrain is the right size for many people; that is one reason these telescopes are popular.

    I have had several Largest Conveniently Portable Telescopes, over the last few cars. Once I built an eight-inch Dobson whose key design parameter was that the tube just barely fit crosswise across my back seat. I used it a lot till I bought a smaller car. For a while, my Largest Conveniently Portable Telescope was a Vixen 90 mm f/9 fluorite refractor on an altazimuth fork or a Great Polaris German equatorial (I have hardware to fit both), but at present I use a six-inch f/10 Intes Maksutov on the Great Polaris. A somewhat faster Dobson than my 8-inch f/5

would work equally well, and would have more performance for most purposes.

- (F.3) Public Star Party 'Scope: You'll want something pretty portable, with the added provisos that it's nice to have a sidereal drive so you won't have to keep re-pointing it between viewers, and that it shouldn't be so expensive you worry about kids and idiots. Your SCT will do nicely.

  I put the Intes or the Vixen fluorite on the Great Polaris, but I set the tripod legs to maximum length, so the expensive optics are out of reach. So far, no one has slam-dunked a rock.

- (F.4) Quick Look Scope: The idea here is to leave something all set up in your entrance hall, or hidden under a stack of old _Sky_&_Telescopes_ in the back of your car, so you will have a telescope on two minutes notice if a truly close comet comes whizzing by, or if you are too lazy to assemble one of your real telescopes. Such an instrument can also double for nature watching or spying on the neighbors, which may be the same thing -- just don't tell your fellow amateur astronomers, or you will lose observer points. Many people have a spotting 'scope on a light tripod, or perhaps a 90 mm Maksutov on one a bit heavier.

  Lately, my Quick Look 'Scope has been a 102 mm f/9.8 Vixen refractor with a conventional achromat, on a Vixen bent-fork altazimuth mount that has clutches and slow motions on both axes. I have a couple of smaller refractors that I sometimes use similarly, but since I have room to leave the 102 mm set up in my living room, I benefit from the extra aperture.

- (F.5) Binocular: A good binocular is very useful, and can do much of the work of a 'Quick Look Scope. I have too many; ones I use for astronomy include the 7x35 Tasco ($29.95 at Sears) that I keep in my car for bird-watching (oops, lost observer points), an old Swift Commodore Mark II 7x50 (long out of production), which was one of the first binoculars I saw with BAK-4 prisms, and an Orion 10x50 and 10x70 with BAK-4 prisms and fully multicoated everything, up to but not including the case. At star parties I tend to wander around with one dangling from my neck. I tried two, but lacked sufficient eyes.

- (F.6) High-Tech Conversation-Stopper: This is how you put to shame those grass-chewing hillbilly clodstompers who have giant cardboard Dobsons with tubes so big that they echo. Odds are the seeing will never get good enough for them to demonstrate that a half-meter shaving mirror will blow eighteen centimeters of optical perfection clean out of the water, and if they start talking about faint galaxies you can always change the subject to diffraction rings and modulation transfer functions, and ask them to compare internal baffles and background sky brightness. Besides, your telescope has more knobs than all theirs put together, and it cost more than all theirs put together, too.

  The default choice for the High-Tech Conversation-Stopper these days is typically an apochromatic refractor, or some close approximation ("apochromat" is a precise technical term; not all superb refractors are apochromats, and vice-versa), which if well made and well baffled will deliver outstanding performance for its size. The apertures available suffice for many amateurs who have either recovered from aperture fever or have not yet succumbed, or who have exhausted their supply of fullbacks and circus elephants to set up the Big Iron. Few other kinds of telescopes qualify -- you're not allowed to have a Schiefspiegler unless you can remember how to spell it, and nobody wants a Yolo because people expect you to walk the doggie. Some folks like Questars, but not me.

  My present High-Tech Conversation-Stopper is the 90 mm Vixen fluorite refractor I mentioned earlier. It is not big enough to be as impressive as I might want, and is rather short on knobs, but I can talk fast enough to make up the difference.

What about accessories?

I have already said most of what you need to know about accessories, which is that (A) aperture wins. If you are planning a telescope budget, and eyepieces, finders, and such account for the lion's share of your funds, sit back and think carefully about what you are about to do -- it might be better to get a bigger telescope instead of fancy accessories. A 10-inch telescope with a hand magnifier as an eyepiece will give a better view of most objects than an 8-inch telescope with the finest eyepieces in the world. Why? Because (A) aperture wins.

Yet if you are up against limits of telescope portability, or have lots of money, or like technology, go ahead and buy fancy accessories. I won't tell, provided you remember that (A) aperture wins.

In any case, I will mention some plain-vanilla accessories that you might want to have, and maybe a few chocolate ones, too:

- (a) Eyepieces. A small number of good ones is better than a large number of bad ones. You will need a low-power, wide-field eyepiece, both for finding things and for low-power views of big, diffuse objects. It might give a magnification equal to five or six times the telescope clear aperture, in inches. On my f/11 Celestron 14, the low-power eyepiece has a 55 mm focal length, and is mounted in a two-inch barrel, so that the front lens -- which sets the field diameter -- can be as large as possible. (In little f/10 or f/11 telescopes, internal baffles may mean that no light gets to the edges of a two-inch wide eyepiece; if so, don't bother with the extra cost of one.) On my f/5 8-inch Dobson, I use a 20 mm eyepiece, which doesn't need a two-inch barrel.

  The next power you will likely reach for is medium to medium high, for a good look at detail in the object in view. Such an eyepiece might give a magnification of 20 to 30 times the telescope clear aperture, in inches. On my C-14 I use a 12.4 mm eyepiece, and on my 8-inch Dobson, a 4 mm. The objects you look at with high power probably won't be very wide (though they might be), so for economy, you might not want a super-wide-field type.

  Your next choices will depend on what you like to look at. If you are not sure, hold off buying more eyepieces till you find out.

"Fast" f-numbers, typical in Dobson-mounted Newtonians, require fancy, expensive eyepieces to give good views, because the steeply converging light cones of these instruments are difficult for an eyepiece to cope with, particularly away from the center of the field. Slower instruments can use simpler eyepiece designs. It is a "Catch-22" of amateur astronomy, that cheap telescopes (fast Dobsons) need expensive eyepieces, but expensive telescopes (most refractors and Schmidt-Cassegrains, with slow f numbers) can use cheap eyepieces.

"Zoom" eyepieces, which change focal length at the twist of a knurled ring, tend not to be very good. Barlow lenses, also called telextenders, multiply the focal length of the telescope with which they are used: It used to be that they generally worked well only with telescopes with large f-numbers, where they were not needed -- another "Catch-22". Yet I have heard that there are now Barlow lenses that work with fast telescopes, where they are indeed needed, but I urge a try-before-you-buy approach to selecting one.

For over fifteen years I used an eyepiece set bought in roughly 1980. It featured no fancy designs, just a 55 mm Plossl, 32, 20, and 12.4 mm Erfles, and 7 and 4 mm Orthoscopics. The 55 and 32 mm eyepieces were in 2-inch barrels, the others in 1.25 inch barrels. All were very good quality -- the 55 and 32 mm were from University Optics, and the others were Meade Research-Grade. All worked reasonably well even at f/5, and the 68-degree apparent field of the Erfles was enough that I was untempted to buy wider-field types. Besides, a big Erfle is already so heavy that I must rebalance the telescope to use one. I did use the 4 mm eyepiece on the C-14 now and then, but occasions where I want that much power are rare.

In mid 1996 I bought more eyepieces, mostly out of curiosity. I found that decent Plossls are comparable to decent Orthoscopics. I bought several Vixen "Lanthanum" eyepieces, which have built-in matched Barlow lenses to give 20 mm eye relief, even at such short focal lengths as 2.5 mm. I don't need glasses to observe, but even so, long eye relief makes viewing more relaxed -- I'm not worrying about bumping the eyepiece. It also facilitates public viewing -- I focus with my glasses on, and tell everyone to leave theirs on and not refocus.

Note what high-tech eyepieces can and cannot do. The best give wider fields of view, with fewer eyepiece aberrations near the edges, than older types. The improvement is most noticeable at fast f numbers. If that's important to you, you might want some. But eyepieces are not aperture stretchers. They can neither increase image detail beyond the theoretical limit for the aperture, nor increase the number of photons that make it to the focal plane. If you think otherwise, you are making the same mistake as the clueless beginner who buys a drug-store refractor because it says "Magnifies 400 Times!!" on the box. The best an eyepiece can do is not make things worse. A simple eyepiece, with good coatings and well-polished lenses, will show all the on-axis detail a telescope has, and absorb almost no light. That's what counts most for astronomical work.

In 1980, I bought 6, 12 and 25 mm Ramsden eyepieces -- an old, simple, design -- for about ten dollars each. I use them at star parties without telling what they are. They have only four surfaces, so simple coatings give good throughput, and there are few chances for bad polish to scatter light and ruin contrast. The field of view is narrow, but on axis, at slow f numbers -- f/10 or longer -- they give up nothing to new designs; images are superb.

- (b) Finders. What kind of finder you get depends on how you use it. If you plan on looking mostly at fine details in bright objects, then you might buy a big finder, in the hope that most of what you look at in the main telescope will be visible in it, too. But that won't work if you push your telescope to its faint-object limits -- you would need a finder as big as the main telescope. You might then consider a finder that will show stars exactly as faint as on your charts. It helps a lot in identifying what you are looking at through the finder, if every star you see is charted, and vice-versa. Once the right pattern of stars is in the finder, you can put the crosshair where the object lies, even if it is too faint to see.

In dark sky, the 10x40 finder on my C-14 shows stars to about magnitude 9.5, which matches my big charts. The 7x35 on my 6-inch Maksutov does almost as well. In suburbia, the 5x24 finder on my 8-inch Dobson goes to about magnitude 6.5 (which would be the naked-eye limit in darker conditions), thus matches many naked-eye star atlases.

Unit-power finders, like the Telrad, let you to stare at the sky with both eyes open and see a dot, circle or crosshair of light where your telescope is pointing. A peep sight, made by taping bits of cardboard to your telescope tube, may work as well, and will be much cheaper, and any magnifying "straight-through" finder (in which you look in the direction the finder is pointing) can be used with both eyes open -- let your brain fuse the images, so you can use the finder's crosshair with the other eye. I tried a unit-power finder (Orion's) on my 90 mm refractor, but found it always inferior to the original 6x30 finder. My opinion about unit-power finders is in the minority. Many prefer them to those which magnify. Some folks use the Telrad's circles of known diameter to measure angular distances when finding things.

- (c) Charts. Preferences vary greatly. What I find useful, in order from simple to complicated, is more or less the following:

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(c.1)   A simple planisphere, preferably a plastic one that won't
        sog out with dew and that may survive being sat upon. It's
        a fast way to find out whether a particular object is up
        before I go observing, or to determine how long I have to
        wait before it is well-placed.

(c.2)   A "pocket atlas". I am particularly fond of Ridpath and
        Tirion's _The_Night_Sky_, from Running Press in Philadelphia,
        PA. It is about three by five inches and half an inch thick,
        and it is out of print. Write Running Press and complain.

(c.3)   A "table atlas", bound as a book that will lie reasonably
        flat, showing stars to the naked-eye limit and lots of
        deep-sky objects to boot. I happen to use an old Norton's
        _Star_Atlas_; there are lots of others.

(c.4)   A "deep atlas", such as _Uranometria_2000_ or the AAVSO
        atlas, with a stellar magnitude limit of 9 or 9.5 and a vast
        number of objects. What's important here is to have enough
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         stars charted that there are plenty in every finder field.

(c.5)    A planetarium computer program (Bill Arnett reminded me).
         If you are a beginning astronomer, I do *not* suggest you
         rush out and buy a computer, but if you already own one, you
         might bear in mind that there are programs that will turn
         your console into a window onto the simulated heavens, with
         features for finding, displaying, and identifying things.
         I happen to have the rather old Voyager 1.2 for my even
         older Macintosh II; there are plenty more, both for Macs
         and for the world of MS-DOS and its descendents.

         Some folks run such a program on a laptop, at the
         telescope. Please put red cellophane over your console,
         if you do.
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I have had limited use for the popular oversize-format charts with lesser magnitude limits, like 7.5 to 8.5; they don't show enough stars to be useful with most of my finders, and are too cumbersome. The plastic-laminated versions make good place mats, though. Everyone should use the box of a Dobson as a picnic table at least once.

- (d) A red flashlight, so you can read your charts and notes without ruining your night vision, or that of people near you. The kinds that have a red light-emitting diode (LED) instead of a flashlight bulb are particularly good. If other observers scream and throw things, your light is probably too bright.
- (e) A logbook. This item is not for everyone, but I find it useful to record my observations, even if I don't do anything other than note that I saw a certain object with a certain telescope and magnification. Logbooks make fun reading when it is cold or cloudy, and often there will be reason to look up something long after the fact. Besides, if you quote frequently from your logbook, you can make your friends think you are an active observer when you really gave it up years ago.

What about observing skills?

Even some experienced amateur astronomers think that seeing things comes free and easy, with no more effort than opening your eyes: But as currently popular slang so evocatively articulates,

**** NOT **.**

Vision is an acquired skill. You must learn it, you must practice, and you must keep learning new things, and practicing them, too. Buying a bigger telescope to see more is like buying a bigger kettle to be a better cook, or buying a bigger computer to be a better programmer. Not that it won't help -- it might -- but cooking and programming depend far more on knowledge and experience than on artifacts. So does visual astronomy. People with garages full of telescopes (pardon me while I try to close the door to mine) are in great part victims of materialism, marketeering, and hyperbole. Practice is cheaper, and works better. As I said near the beginning of this article, an experienced observer may see things with a small telescope that a beginner will miss with an instrument five times larger, even with objects and sky conditions that favor both equally.

What skills may you hope to cultivate? What techniques should you practice? Not all have names, but here are a few, in what I think is order of importance; what matters most comes first.

- (a) Patience. It can take a long time to see everything in a field, even if you know exactly what you are looking for.
- (b) Persistence. Eyes, telescope, and sky vary from night to night.
- (c) Dark adaptation. Avoid bright lights before observing: It takes your eyes hours to reach their full power of seeing faint objects.
- (d) Averted vision. The part of your retina that sees detail best, sees low light worst. Look "off to the side" to find lumps in the dark.

  Many observers use averted vision on faint objects, but not for faint detail in bright ones. Detecting something doesn't mean you've seen all you can. Don't let the dazzle of a galaxy's lens keep you from tracing spiral arms out beyond the width of the field. How about increasing magnification, and using averted vision to see if you can see more detail in the paler, but larger, image?

  Averted vision helps with double stars, when one star is much fainter than the other, even if the faint star is bright enough not to need averted vision if it were by itself. That is, averted vision seems to facilitate the detection of low contrasts as well as faint objects.
- (e) Stray light avoidance. Even when it's dark, background glow interferes with detecting faint objects. Keep it out of your telescope and out of your eyes. Try eye patches and eye cups for eyepieces. My first view of the Sculptor Dwarf Galaxy was with my jacket collar pulled up over my binocular eyepieces. I looked like a cross between the Headless Horseman and the Guns of Navaronne, but I saw the galaxy.
- (f) Moving the telescope. The eye sometimes detects motion, or changing levels of brightness, more easily than static images. Jiggle the telescope, or move it back and forth, to make an object "pop out". Try it while using averted vision.

- (g) Not moving the telescope. The eye sometimes adds up photons over many seconds; if you can hold your eye still for a long time, faint things may appear. Try it with averted vision.
- (h) Respiratory and circulatory health. If you smoke, try taking a break before and during observing -- carbon monoxide from incomplete combustion interferes with the ability of the blood to transport oxygen.

Clear sky, and enjoy your telescope.

What Does All the Jargon Mean?

OK, by popular request, here is a glossary of common astronomy terms encountered in amateur astronomy.

altazimuth mount
: This is what you think of when you think of a tripod mount. It allows movement in two directions: parallel to the ground (azimuth), and at right angles to the ground (altitude). It is very useful for terrestrial observations, as it is a very natural way of observing. (Note: Dobsonian Telescopes are mounted this way)

aperture
: The diameter of the objective.

Barlow
: A Barlow lens is a device which has the effect of increasing the magnification. It does this by lengthening the effective focal length of the telescope you are using. Thus a 2x Barlow will double the magnification, a 3x will triple it. Barlows used to have a bad reputation, stemming largely from rather poor quality ones being sold. Modern Barlows are high quality and a good choice for expanding your collection of eyepieces. You should keep the Barlow in mind when buying eyepieces- buying a 3mm,6mm, 12mm, and a 24mm and a 2x Barlow is a very dumb idea. The only use you get from the Barlow is changing the 3mm to a 1.5mm (which is probably going to give you higher than usable magnification anyway). On the other hand, a 6mm, 9mm, 15mm and 24mm would be complemented very well by a 2x Barlow.

catadioptric
: Any of a number of compromise telescope designs, using both a lens and mirrors. Examples are the Schmidt-Cassegrain and Maksutov-Cassegrain. Because the light path is folded twice, the telescope is very compact. These are pretty expensive. Pictures can be seen in the ads in any issue of a popular astronomy magazine: the Meade 2080 and the Celestron C-8 are examples of Schmidt- Cassegrain; the Celestron C-90 and Questar are examples of Maksutov-Cassegrain.

chromatic aberration
: In refractor telescopes, which use lenses to bend the light, different wavelengths of light bend at different angles. This means that the stars you see will usually have a blue/violet ring around them, as this light is bent more than the rest of the spectrum. It is not present at all in reflectors, nor to any significant degree in catadioptrics. Different glasses and crystals (notably fluorite) are sometimes used to compensate for the aberration. Such telescopes are termed "achromat," or "apochromat" if the correction is is nearly perfect.

collimation
: This refers to how correctly the optics are pointing towards each other. If a telescope is out of collimation, you will not get as clear an image as you should. Refractors generally haved fixed optics, so you don't have to collimate them. Reflectors and catadioptrics usually have screws that you turn to collimate. (This only takes a few minutes to do- it is dead easy).

coma
: This refers to the blurring of objects at the edge of the field of view, most common in short focal ratio Newtonian telescopes (at f/10 and longer, Newtonians are very well corrected for coma).

Dobsonian
: Named for John Dobson of The San Francisco Sidewalk Astronomers (who prefers to call these "Sidewalk Telescopes"),this is a design which allows for very large apertures at very affordable prices. The trade-off is that they are mounted on altazimuth mounts, instead of equatorial ones, which makes them essentially useless for astrophotography, but an inexpensive alternative if you only plan to do visual work. These are light buckets. If you are planning to build your own telescope, you might want to consider a Dobsonian. Note: That this design is now the #1 Design seen at many Star partys.

equatorial
: An equatorial mount is set to the current latitude, and is polar aligned (pointed at the North Pole in the Northern Hemisphere, the South Pole in the Southern Hemisphere) and then moves only in Right Ascension and in Declination. This take a while to get used to, but offers the wonderful side effect of being able to track the astronomical objects you are looking at as they move across the sky (which is very visible motion at telescopic magnifications) by moving in only one direction (Right Ascension). Most equatorial mounts come with motor drives that take care of this for you.

exit pupil
: This refers to how wide the beam of light exiting the eyepiece is, and is equal to the aperture divided by the magnification. If it is bigger than the size of your pupil in the dark (7mm when you are young, 5 or 6mm when you are over 40, as a general rule) you will not be taking in all the light available- effectively, you will be using a smaller aperture telescope than you have.

eyepiece
: This is the thing you actually look into. Almost all telescopes separate the Optical Tube (the telescope proper) from the eye piece. Essentially, the telescope makes a really tiny image of what it's pointed at. The eyepiece acts as a magnifying glass to allow you to see the image bigger than it would otherwise be. The magnification is the focal length of the telescope divided by the focal length of the eyepiece. Eyepieces are described by the diameter of the barrel, always expressed in inches (.965", 1.25" and 2" are the sizes in common use) and the focal length always expressed in millimeters (4mm - 40mm is the usual range). Short focal length eyepieces are also termed high power, long focal length are low power.

: Also significant with eyepieces is the apparent field of view (expressed in degrees) and eye relief (expressed in millimeters). The apparent field refers to how big the circle of space you see in an eyepiece appears. Bigger is better. Eye relief is a measure of how far from the eyepiece you can have your eye and still see. If you wear glasses to correct astigmatism, you will need fairly long eye relief (the focus knob will correct for almost all vision problems except astigmatism).

There are several types of eyepiece designs. The most popular are Kellner (inexpensive, most popular for cheap telescopes, short eye relief and narrow fields of view. Good to avoid if you can afford better); Orthoscopic (good price/performance compromise); Erfle (wide field of view, expensive); Plossl (perhaps the best all-around eyepiece. Some moderately expensive versions available); and Ultra Wide (very expensive, almost double the number of lenses as other designs makes for more light loss in the eyepiece, large exit pupils. Can cost more than a small telescope. Not a good place to spend your money when you are just starting out).

You really don't want to buy many .965" eyepieces- they are generally not as well made as the 1.25" ones, and if you get a bigger telescope it will probably not accept your .965" eye pieces. You can buy an adapter to let you use 1.25" in your .965" focuser. This is probably worth the money.

f/10, f/6.3
: See Focal Ratio

finder scope
: The finder scope is a low power telescope attached to the telescope you are using. Because most telescopes show such a small portion of the sky, it is virtually impossible to locate anything just by looking through them. So you look through the finder scope to center the object you want (the finder has crosshairs) and then you can use your real telescope on it. Note that you can ignore all the claims about big finder scopes. You almost certainly don't care. All you need is to be able to point your main telescope at something in the sky. Finder scope size only matters when you are starhopping through fairly dim stars (where the larger aperture allows you to see dimmer stars). This will not be an issue for you for quite a while (if ever). Many people use a Telrad sight, which is simply a red LED you can sight on- you get absolutely no more aperture than your naked eye. The finder scopes are usually advertised as 8x50 (or such). The eight refers to the magnification, the 50 to the aperture in millimeters-just like binoculars.

focal length
: This is the length of the light path, from the objective to the focal plane. The magnification is the focal length of the telescope divided by the focal length of the eyepiece. See also focal ratio.

focal plane
: The plane that the telescope (or eyepiece) focuses on. When you turn the focus knob on the telescope, you are moving the eyepiece back and forth until you make the two focal planes coincide.

focal ratio
: Also referred to as the "speed" of the telescope, is the ratio of focal length to aperture, and is always expressed as an f/number. Thus an 8" telescope with a 2000mm focal length is f/10 (because 8" is 200mm, and 2000 / 200 = 10). An f/10 telescope is "slower" than an f/4.

  Fast telescopes give wider, brighter images with a given eyepiece than slower ones (but note that at a given magnification, the images are-assuming identical optics-exactly the same: what you see through a f/6.3 telescope with a 12mm eyepiece is identical in width and brightness to what you would see through a f/10 telescope with a 19mm eyepiece).

  In general, the slower the telescope the more forgiving it is of optical errors in the objective and eyepiece. A telescope of f/10 is fairly forgiving, f/6.3 much less so.

focuser
: This is the thing that holds the eyepiece. It moves in and out so you can focus the telescope. It is always included with the telescope when you buy one. The size, almost always .965", 1.25" or 2" refers to the barrel diameter of the eyepieces it accepts.

fork mount
: A fork mount is a type of mount where the telescope is held by two arms, and swings between them. A fork mount can be either alt-azimuth or equatorial (through the use of a wedge). Fork mounts are most commonly used with Schmidt-Cassegrain telescopes, and are almost always equatorial.

German Equatorial Mount
: The first equatorial mount devised and still the most common for small to moderate sized reflectors and refractors. Unlike the equatorial fork, the german equatorial is suitable for telescopes with either short or long tubes (although, if poorly designed, a long tube may strike the tripod, preventing viewing at the zenith). They usually are designed with movable counterweights, which make them easy to balance, but heavy and bulky.

  The tube of the telescope is joined to a shaft (the Declination shaft or axis) which rotates in a housing that in turn is joined at right angles to another shaft (The polar axis). The polar axis is pointed at the celestial pole (just like any other equatorial mount). A counterweight, which is required for balance, is placed on the other end of the decination shaft.

  Tracking an object past the zenith requires that the telescope be turned (both Right Ascension and Declination rotated through 180 degrees), which reverses the field of view. Not so much a problem for visual astronomy, but a limitation on astrophotography.

light bucket
: A common slang term for a large aperture. The cure for "Aperture Fever."

Maksutov-Cassegrain
: See catadioptric.

Meridian
: An imaginary north/south line passing through the zenith.

Newtonian
: See reflector.

objective
: This is the thing that gathers light from the sky and folds the light into a cone. In a refractor it is the big lens that points at the sky, in a reflector it is the big mirror at the bottom of the tube. The job of the objective is to create a light cone which comes into tight focus at a single focal point.

optical tube
: This is the telescope proper. It is the tube which holds the objective. The rest of the stuff are accessories, such as the mount, tripod, and eyepieces. When reading ads, note that some times optical tubes are sold by themselves. You will need to go out and buy (or build) a mount for them before you can use them.

reflector

A reflector is any telescope which uses a mirror as its objective. The most common type is the Newtonian reflector, which has a mirror at the bottom of a tube, which focuses the light into a cone which is deflected by a flat "secondary" mirror (which is mounted near the top of the tube in something called a "spider") out a hole in the side. This is where you put the eyepiece. The advantages of the Newtonian design are numerous: there is only one optical surface on a mirror, as opposed to two on a lens, so it is cheaper to make; part of the light path is at right angles to the length of the tube, so it can be somewhat shorter than a similar refractor; you can get it in much larger apertures than a refractor, and there is no chromatic aberration .

refractor

This is what you usually think of as a telescope- it has a lens at one end, and you look straight through the other. This is sometimes referred to as a "Galilean" telescope, as it is of the same design that Galileo used (although strictly speaking, a Galilean telescope is a specific kind of refractor- one with a simple double-convex objective lens and a simple double-concave eye lens.

right ascension

See declination.

Schmidt-Cassegrain

See catadioptric.

spherical aberration

A problem where a lens or mirror in a telescope is not shaped correctly, so the light from the center is focused at a different location than the light from the edges. You should never have to worry about this. This only shows up in really cheap telescopes.

spotting scope

A small telescope, always a refractor or catadioptric, generally used for terrestrial viewing. Of limited utility for astronomy, though many are marketed as such. Probably the wrong choice unless you want to use it also for birdwatching, or as a powerful telephoto lens on a SLR camera.

wedge

This is the thing that a fork-mounted Schmidt-Cassegrain tele- scope will attach to, to connect it to the tripod. You want it to be sturdy.

worm drive

This is the sort of drive most telescopes come with, if they come with a drive. It is a very accurate and smooth drive. However, due to imperfections in the manufacturing process, there will be periodic errors that occur at the same point in every worm cycle (usually about 8 minutes). To deal with this, higher end telescopes come with drives which compensate for the mechanical defects.

zenith

The sky directly overhead. An object "transits" when its line of right ascension crosses the zenith.

What Are Some Good Introductions To Amateur Astronomy?

In the United States, there are two popular astronomy magazines: *Sky and Telescope* (S&T), and *Astronomy*. Of the two, S&T is more technical, while Astronomy has more things like "artist's conception of Jupiter-rise on Ganymede" which are very pretty. I consider S&T a necessity, but getting both is not a bad idea.

P. Clay Sherrod's *A Complete Guide to Amateur Astronomy*, available through Sky Publishing Company, is a more technical introduction. Sidgewick's books are absolutely excellent books,probably the very best ever written on amateur astronomy.

Nightwatch by Terence Dickinson is a good introductory book on Astronomy. Great section on purchasing a telescope. Star charts are so-so.

The Backyard Astronomer's Guide by Terence Dickinson and Alan Dyer. A comprehensive introduction to astronomy and the equipment amateurs like to use. Written by and for amateur astronomers.

Also see below, the section on Books and Starcharts.

What Will I Be Able To See?

The best way to find out is to go observing with someone. Look for a local astronomy club (S&T lists them periodically). This is also a very good way to get a good price on a used telescope of proven quality.

In general, you will be able to see all planets except Pluto as disks.You will be able to see the bands and Red Spot on Jupiter and the rings around Saturn. You may be able to see the ice caps on Mars (although Mars is probably the most disappointing object in the Solar System). Venus and Mercury will show phases but not much else.

You will be able to see four of Jupiter's moons as points. Ditto Saturn's moon Titan. You will be able to see comets.

Do not expect your images to be anywhere as nice as the ones you see from the Voyager spacecraft. If a $2000 telescope could get these, nobody would have spent billions of dollars to send a spacecraft out there.

As far as "deep sky" objects, you will be able to see all the Messier objects in most any modern telescope. Galaxies will tend to look like bright blobs. Look a while longer and you may find some spiral arms or dust lanes (assuming it has them). Galaxies look nothing like their pictures - you will not see the arms anywhere near as clearly.

You will also find that the colors you see are considerably more muted than the pictures you see. This is because our retinas work by having two different types of light sensitive organs, rods and cones. Rods are very sensitive to dim light, but relatively useless for color vision. Cones are the opposite. Thus when looking through a telescope you are using your rods,and you aren't seeing a lot of color.

Buying A Telescope

What Company Makes the Best Telescopes?

This is a very unfair question at the best. There are many companys which make good telescopes. A lot will depend on just how much you want to spend for a telescope. The Major companys that make and/or sell telescopes are as follows: Orion Telescopes, Meade, and Celestron, but you have to be carefull with what you buy from even these companys,as they ALL are selling telescopes which are coming from Prison factorys in 'RED CHINA' and are the same as the Junk department store telescopes. There are other smaller companys that make good scopes too. There are some Japanese companys that are selling some very good telescopes and also some poor ones too.

Televue has a very good reputation, at a somewhat higher price.

Tasco is sold at Toys R Us, K-Mart, & Wal-Mart,etc. Waste of Money. **Notice:** Tasco has taken over Celestron, they are now one company, only time will tell if this inproves Tasco or Degrades Celestron.

Simmons: Total waste of money, worst than Tasco.

Bushnell: I have looked at this companys telescopes 1st hand and I do not belive that they would withstand one full night of useage viewing the sky. They are even WORST than Simmons! They are so bad they make Tasco junk look good!

There are now a lot of smaller companys poping up that are selling the same 'Made in Red China' telescopes uder names never seen before it would be a good idea to stay away from them too.

There are some companys importing telescopes from Russia, I have not seen these scopes first hand, but have read some good reports of them.

What Is The Best Telescope To Buy?

Once more this will depend on the answers of questions you need to ask yourself. Are you going to use the telescope for just viewing? or are you going to into the field of Astrophotography? Also it will depend on how much you want to spend too. In the end,only YOU can answer this question.

No FAQ list is going to be truly definitive - we all have our own opinions and interests, and one person's "piece-of-junk optics" might be another person's dream telecope. This does not apply to department store telescope, though. Really.

As the numbers of companys who now either make and/or just sell Telescopes of ALL price ranges, the list is just to much to put into this FAQ, instead, the next section will list a number of both large and small companys that market telescopes. The best idea would be to contact the comapnys and find out what kind of telescope they market in your price range. Then if you can, Find one of those telescopes at a Star party.

OK, Where Do I Buy My Telescope?

Well, there are three basic places:

- **A Store** Yes, the obvious-you find a store (NOT a department store) which sells telescopes and write a check (or, if they won't give you a cash discount, use a credit card that offers buyer protection, or gives you bonus miles, or some such).

  The advantages of this method is that you have someplace to return the telescope to if you have problems with it. Some places even offer your money back if you change your mind within some grace period.

  The disadvantage is that you generally pay more for the telescope itself, and you pay sales tax.

- **Mail Order** There are two sorts of mail order: the discount stores that sell all sorts of stuff through the mail, and telescope stores that sell through the mail in addition to selling from their store.

  The advantages and disadvantages of mail order are obvious: you cannot take the merchandise back easily if something goes wrong, but it's cheaper and you probably pay no sales tax.

- **Other People** You can find some great deals in used telescopes. Many people buy expensive telescopes, use them two or three times, get bored and sell them. The advantage is strictly monetary: you pay significantly less (and,of course, no tax).

  The disadvantage is that you are buying something "as is" which you may want to think twice about doing if you are buying an expensive telescope. Also, both Meade and Celestron offer (limited) lifetime warranties on their optics, which are not transferable.

All that having been said, here is a list of places you can buy telescopes, with comments as applicable. Note that not all will sell or will ship. To you, some you must go to a store.

Orion Telescopes
P.O. Box 1158
Santa Cruz, CA 95061
(also San Francisco and Cupertino)
800-447-1001
sales@oriontel.com

Orion Telescopes carries a wide selection of binoculars, telescopes, and accessories (Celestron, Tele Vue, and their house brand; they do not carry Meade). They have a 30 day "no questions, satisfaction guaranteed" refund policy, which they do seem serious about. A fair number of people (myself included) have bought at Orion and all are very satisfied with the way they were treated. If you need technical assistance when you call, ask for Steve or Eric. They have a very good service and support record.

Lumicon
2111 Research Dr. #5
Livermore,Ca.94550

While I have not had any dealings with this company,the messages I've seen on sci.astro.am have all had good things to say about them.

Astronomics
2401 Tee Circle Suites 105/106
Norman, OK 73069

Higher prices than Adorama and Focus (see below),but lower than Orion and Lumicon. Enthusiastically recommended by a couple of people on the net. As with all mail order, make sure the shipping price is included.

Celestron International/TASCO.
2835 Columbia St.
Torrance,Ca.90503

This company also sells many types of telescopes. From SCT's to DOBs. Have seen both Good and Bad posted about them. As Noted above this company is now owned by TASCO.

Mag 1 Instruments
16342 Coachlight Dr.
new Berlin,Wi.53151

Markets their 'Portaball' style DOBs in 8in and 12.5in size.

Meade Instruments Corps.
6001 Oak Canyon
Irvine,Ca.92620

Markets many types of Telescopes, from junk to High End.

Coulter Optical
Div. of Murnaghan Instruments
1781 Primrose Ln.
West Palm Beach,Fl.33414

They market a full line of DOBs.

Obsession Telescopes
P.O.Box 804a
Lake Mills,Wi.53551

Markets Dob's from 15in to 30in!

Pocono Mountain Optics
104 N.Plaza
Moscow,Pa.18444

Enthusiastically recommended by a few people on the net.Owned by Glenn Jacobs who goes to most of the astronomy get-togethers in the NY-NJ-PA-CT area so you actually meet him if you live in the area. Often willing to cut a package deal if you are buying big ticket items. No problems returning things with which you are dissatisfied.

Roger Tuthill
11 Tanglewood Lane
Dept. ST

Mountainside,N.J. 07092

Enthusiastically recommended by a person on the net. Not the least expensive, but top-notch service. Roger unpacks, inspects and collimates every scope he sells, and is very good about refunding your money if you are dissatisfied.

Stargazer Steve
1752 Rutherglen Cr.
Sudbury, Ontario
P3A 2K3 Canada

Markets a 4 1/4inch DOB in both Kit form and/or ready-to-use. Both under $300.00.

Starsplitter Telescopes
3228 Rikkard Dr.
Thousand Oaks,Ca.91362

Markets DOBs from 8in to 30in.

University Optics
P.O.Box 1205
Ann Arbor,Mi.48106

A few people have reported using University Optics, and all report receiving good service. I have heard no complaints.

Parks Optical
270 Easy St.
Simi Vally,Ca.93065

A couple of people have mentioned that shipment can be pretty delayed,but the quality of their equipment appears to be high, and improving.Salespeople vary from knowledgeble to bubbleheaded.

Adorama
42 West 18th Street
New York, NY 10011
orders: (800) 223-2500
info: (212) 741-0052

Along with Focus Camera (see below), the lowest prices you will find. Expect no dealer support, and make sure you find out how much they will charge for shipping before placing your order. And pray that the optics arrive intact. I really would recommend that you not buy telescopes from these guys. Eyepieces and other accessories, however, are probably worth the risk if the price difference is significant.

Focus Camera
4419-21 13th Avenue
Brooklyn, NY 11219
orders: (800) 221-0828
info: (718) 436-1518

Refer to Adorama. Same comments apply.

Pauli's Wholesale Optical
Danbury, CT

A lot of bad reports, order at your own risk!

Also there is the AstroMall.

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**                                                             **
**                     A S T R O - M A L L                     **
**                                                             **
**     ONE STOP ASTRONOMY SHOPPING AND PRODUCT INFORMATION      **
**                                                             **
** See in-depth product information for such companies and     **
** products as:                                                **
**                                                             **
** Tele Vue Optics, Edwin Hirsch, Spectra Astro-Systems,       **
** Lumicon, Software Bisque, Astro-Cards, Astronomical         **
** Adventures, Bethany Sciences, Equatorial Platforms,         **
** Jim Kendrick Studio, Science Software, Celestial Products,  **
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What About Building A Telescope?

This section was written by Andy Michael.

We just took a rather unusual approach to getting a beginning telescope: we took John Dobson's telescope building class and built an 8"and a 12.5" reflector on Dobsonian mounts (of course). We went this way for a few reasons: to get large aperture for seeing deep sky objects and higher magnification with good resolution when compared to small refractors in this price range, to keep the price down, and to soak up John's wit and wisdom. The down side is that these telescopes are not suited for astro-photography (at least not without building a different mount) but that didn't bother us. Also they are large. The 8" tube we broke into two pieces for easy portability, but the 12.5" one will probably go on the roof rack. These are about f/7 telescopes so the tube lengths are 56" and 7' respectively. Of course, when you build yours you can make whatever size you want. On the other hand you can pack your clothes in them; try that with an SCT. The cost was about $250 for the 8" telescope, $450 for the 12.5"er plus about 24 to 30 hours of work and 16 - 24 hours of class. It's a challenging project but the first time you focus on something with a mirror you ground is an incredible thrill. Another benefit is that we now know a lot about telescope design and if we ever have problems with them we know how to fix them.

If you don't have access to John's (or other peoples) classes then you can try building one by reading his book and by watching the video. Our class was the first to see parts of the video and had great success at finishing the telescopes fast and without needing to correct the mirrors very much. Coincidence? Class consensus was no.

The book (excerpted from the order form): "How and Why to Make a User-Friendly Sidewalk Telescope" by John Dobson with Norm Sperling.To appreciate why Dobson makes each factor just so, learn how he thinks about it. His philosophy of star-gazing perfuses his telescopes and his book. The book includes the only detailed biography;wonderful vignettes from the Sidewalk Astronomers'many expeditions;their own special way of describing celestial objects; and, of course,complete details for making a Dobsonian. 169 pages; 154 clear,friendly line drawings; 9 photos. Hardbound in plywood, Dobson's favorite material. Exclusive source. Send $39.95 + $5.00 shipping to Everything in the Universe, 185 John Street, Oakland, CA 94611.

The video (also excerpted from the order form): For the first time on video, John Dobson shows how you can build your own low-cost Dobsonian Telescope. The 90-minute video is a complete step-by-step guide, covering telescopes from 8 inches to 16 inches in diameter. $39.95 +$3.50 shipping.

What is the Best Mount?

EQUATORIALS Vs. ALTAZIMUTHS: THE TRUTH
David Knisely

The various telescope mounting systems available for use by amateur astronomers have been discussed at length on sci.astro.amateur. There has been a great deal of debate, a little ill-informed opinion, and some real misconceptions concerning each of the basic mounting schemes, so perhaps it is time to clear the air. One basic and irrefutable fact must be stated up front: NO MOUNT SYSTEM IS PERFECT FOR ALL SITUATIONS! Any attempt to champion one mount scheme over another without considering all the facts is doomed to failure. Below are the true advantages and difficulties of the two most popular mounting sytstem.

The ALTAZIMUTH (ie: Dobsonian, ect.). This mounting system has gained considerable popularity over the past 20 years, evolving from the old "pillar and claw" system originally used only in inexpensive small telescopes, to a modern well-designed one which boasts of supporting some of the largest apertures in amateur astronomy today.

Altazimuth Advantages

1. Simple and stable mounting system requiring no axis counterweights or heavy off-center concentrations of weight to induce vibration or mount flexure problems. Only two vertical and one horizontal bearings are needed.
2. Easy and intuitive mount for beginners to learn on.
3. More portable than many equatorial mounting schemes, especially for apertures over eight inches (often faster setup time).
4. Easy to build, and often allows simpler mirror-support schemes to be used.
5. Lower overall cost, especially for large apertures.

Altazimuth Disadvantages:

1. Unable to track objects with single axis motor drive system. For long term tracking, an altazimuth must be computer dual-axis controlled, or supported on an equatorial platform (only 1.25hrs maximum tracking time on such a platform). Cannot track objects directly through the zenith in dual axis driven mode ("Dobson's" hole).

2. Lack of fixed field orientation makes star hopping the primary mode of faint object location in non-computerized altazimuth mounts (right-angle sweep and R.A./Dec. setting circles cannot be used). Objects not located in easy-to recognize starfields can be more difficult to find manually.

3. Changing altitude and azimuth coordinates can make finding objects more difficult using only altitude and azimuth circles, often requiring computer readouts or nearly continuous manual calculations to keep track of pointing directions for locating objects.

4. Field rotation limits photography to short exposures (unless expensive field de-rotators are used). Guiding long exposures can be very difficult,since corrections for drift are sometimes non-intuitive.

EQUATORIAL MOUNTS: These mounts are aligned to the celestial coordinate system, and have been the mainstay of serious amateur and professional astronomical telescopes for over a century. They come in a variety of designs: German Equatorial, English Yoke, English Cross-axis, Polar disk, Fork, Split Ring, ect.

Equatorial Advantages

1. Can use one "clock-drive" motor to drive the telescope in right ascension for long-term tracking of celestial objects.

2. Most equatorial schemes (except for Yoke mount) can reach and track through all areas of the sky.

3. No field rotation enables easier long-exposure photography with more intuitive guiding corrections. Also makes planetary observations a bit easier, since the object in the field does not rotate.

4. Finding techniques such as the "right-angle sweep" or star drift method can be used to make locating faint objects easier and faster, even with non-clock driven scopes (only one nearby visible reference star is needed).

5. R.A./Dec. Setting circles (both digital and analog) can be used for locating non-visible objects. Digital circle design for equatorial scopes can be simpler, since no real-time guiding calculations need to be performed.

Equatorial Disadvantages:

1. Good Equatorial mountings tend to be bulky and heavy, making them less portable than some altazimuth designs (often have to be broken down into many smaller components for transport).

2. German Equatorial mount requires heavy counterweight on a long shaft to make the scope balance. This can be a problem in the dark with people running into them. German Equatorial mounts can also have problems with the scope running into the pedestal for some objects near the zenith, requiring a "roll over" reversal for continued tracking.

3. Moment arms of equatorial mounts tend to allow flexure and vibration to become problems unless the mount is heavily overbuilt. Fork mount tines tend to flex, making for mild tracking errors and periodic lower-frequency "pogo" oscillation vibration problems with heavy scopes and longer tine length.

4. Good Equatorial mounts usually have four bearings, and can often be more expensive than altazimuth mountings (they can still be home built, however).

5. Proper polar alignment is necessary for accurate tracking.

6. Less intuitive for beginning amateurs, although once the amateur gets used to them, the amateur can often find and track objects faster and more easily than with altazimuth mountings.

NOTE: none of these disadvantages will eliminate a mount design from use by the amateur. For strictly visual use (especially for the beginner), the altazimuth can easily be recommended, while for long-exposure photography, the equatorial is often the mount of choice. For very large apertures intended for easy portability, the altazimuth almost has to be used. However, the compact split-ring equatorial design can also remain fairly portable even with telescopes as large as 18 inches. Computers and computerized driving systems have narrowed the choice between the two mounting systems (and driven up their prices), but their basic characteristics have not changed. In any case, both the altazimuth and the equatorial have a firm place in amateur astronomy.

What Accessories Will I Need?

In addition to a telescope, you absolutely must have a mounting and a tripod. You will also need a few eyepieces, a telescope with only one eyepiece is like a

piano with one key.

These accessories don't come cheap, expect to pay as much for the mounting and tripod as you paid for the optical tube. For a first telescope,you probably will want to buy an entire system it tends to be less expensive that way.

Which eyepieces should you start with? I'd suggest three or four, maybe a 30mm, 25mm, 20mm, 8mm and a 2x Barlow (which will give you coverage of 30,25, 20, 15, 12.5, 10, 8, and 4 mm). Buy eyepieces of like quality to your telescope. Putting a $300 Nagler eyepiece on a $150 telescope is pointless (it would also probably tip over the entire telescope).

What Are Digital Setting Circles

This section was written by Jim Van Nuland

9.1 What Are They?

Digital Setting Circles (DSCs) are a small special purpose computer, mounted on or near a telescope. The scope has shaft encoders attached to sense the motion of the scope's axes, and the computer then converts these motions to the position of the telescope, and displays it (for instance) in Right Ascension (RA) and Declination. An 8-conductor cable runs from the computer to the encoders, with 4 wires to each encoder. RJ-45 telephone connectors are used at the computer.

They do NOT move the scope. You push it by hand, and the DSCs tell you which way to move and how much.

What makes DSCs so desirable is that they work on alt/az-mounted scopes; and even with equatorial mountings, it is not necessary to polar align the mount. (However, it's desirable to have the mount at least roughly polar-aligned so it follows an object.)

Additionally, most models have an internal catalog and a "guide" mode.One selects an object (or, in some,a planet), and the DSCs tell which way to move each axis.

They are marketed by Lumicon, Jim's Mobile, Inc., Celestron, and Orion Telescope Centers. The various brands and models differ mostly in their internal catalogs of celestial objects. All are actually manufactured by the same company, Tangent Instruments of Palo Alto, California, USA, who, however does not sell directly to individuals. I own the NGC-MAX from JMI, so some of my statements may not apply to other versions.

9.2. Must the ground board be leveled?

No. An alt/az mount must have a fiduciary mark such that the tube can be placed accurately at 90 degrees to the elevation axis. One way to do this is to (one time only) level the ground board, then the tube. Make the mark in such a manner that it can be adjusted when something changes. Some models of DSCs allow an alt/az mount to be initialized in a vertical position. When starting the DSCs, the tube must be set horizontal (or vertical), and then two stars are used to align. The stars must be at least 20 degrees apart in the sky (90 is ideal), and the first may not be Polaris.

9.3. How does one set up an equatorial mounting?

If the mount is known to be accurately polar aligned, you may still use two stars as mentioned above. Or you may set the DSCs to take advantage of the known alignment, and it will require only one object,and no zero degree reference mark is needed.

If an equatorial mount is not polar aligned, it must have a reference mark at zero degrees declination, and must use the two-star setup. For a German mount, the mark may be on either side of the scope (tube pointing east or west), and the DSCs set to correspond. The mount may be driven or undriven. As for an alt/az mount, the stars must be at least 20 degrees apart, and the first may not be Polaris.

9.4. Do the DSCs support a Poncet platform?

Probably depends on the model. The NGC-MAX provides telescope type ET(equatorial table). It assumes that the table is carrying an alt/az scope, and that the scope is initialized with the tube horizontal. I believe that an equatorial mount could be used, but have not tried to simulate it.

9.5. How accurate is the device?

The position of the scope is displayed to one minute of RA and 10 minutes of dec. Guide mode displays position error to 0.1 degree of arc. The actual accuracy depends on the care with which the alignment was done, the accuracy of the mounting, accuracy with which the shaft encoders were installed, the resolution of the encoders, and a bit of luck. If the level or zero was not set accurately, the system will work poorly, and it should be re-started. If star settings were done carelessly, one can simply re-do one or both of them.

The "luck" factor stems from the digital nature of the shaft encoders. If the encoder is on the verge of a step, you could be off by one step.

The absolute theoretical resolution is three encoder steps, assuming everything else is perfect. In practice, I get about 0.2 to 0.3 degrees, and closer near the alignment stars. If I move a long way across the sky, the error is perhaps 0.5, but then I re-align on a convenient nearby star. It's not too unusual to get 0.1 if all has gone especially well during alignment. This with 4000 step encoders.

Accuracy is best between the alignment stars, and the DSCs calculate a "warp" so as to spread out the error. When re-aligning, only one star sighting is needed. The DSCs retain only the two most-recent star settings, provided they are at least 20 degrees apart in the sky.

9.6. What objects are in the internal catalog?

This is the major difference between models. All have a few dozen named stars, used especially for initial alignment. Some have the planets. The Lumicon models have a catalog of planetary nebulae, which is Dr. Jack Marling's specialty.

The NGC-MAX version 3.94 (July, 1992) has the planets;28 user defined objects; the Messier catalog (including M40 and M110); the full NGC,including the so-called "non-existent" objects; about half of the IC catalog; a catalog of 951 interesting stars (multiple, red, variable);and a list of 367 additional deep-sky objects, many of which are very faint.

For each object, the catalog has the position, magnitude, size (diameter or separation), constellation, name (if any) and/or catalog number, and the type of object. Some have a word or two of description. This probably varies with the brand and model.

9.7. May I add my own objects? Comets, for instance?

The NGC-MAX accepts user objects, and I presume most other high-end models do as well. I like to put in the Sun and Moon, so that I can align during the day. This must be done carefully, with the Sun filter attached. THIS IS DANGEROUS, as the filter must be removed when sighting on the Moon, and if you come back to the Sun, you MUST have first re-attached the filter! The moon is a poor alignment object because it has up to a degree of parallax, and it moves about 0.5 degrees per hour. But it provides a start, and it may be enough to locate some bright stars, and re-align.

9.8. What is "identify" mode?

Identify mode is present in the NGC-MAX, and probably other models. One specifies the class of object, and the faintest magnitude, then the DSC selects the nearest to the telescope's position. Very nice, but in the Realm of Galaxies, alignment is critical and then there are too many to be certain. To check, read out the magnitude and description, and go to Guide mode and see how far away the object is.

It's especially useful in clouds, as one may point the scope into a clear spot, then ask what is nearby. One must separately search for galaxies, clusters, etc.

Identify mode runs continuously, so that, as the scope is moved, the DSCs will (after a few seconds), indicate the new (or nearest) object.

Some models allow alignment on ANY catalog object, which is helpful, but I find that accuracy is best on stars or very round objects. I find that planetary positions are especially suspect. The computer carries only the date, not the hour. (Use UT date.) I have often had poor alignments when using planets, and do so only for daylight set- ups; I re-align on stars as soon as I can find any. Open clusters are especially unreliable; galaxies are not much better.

9.9. Can it replace star charts?

For comparatively easy objects, probably. In a crowded field, no.Some models support the Tiron Atlas 2000 and the Uranometria 2000, by indicating, for each object, the page on which it (the object) will be found. These models also indicate the chart corresponding to the position of the scope, regardless of specific object.

9.10. What other functions are present?

This varies heavily with model. The NGC-MAX (here we go again) has two that have not already been discussed.

"Timer" counts up in hours, minutes, and seconds. It can be stopped,reset, and re-started, but can't be restarted without first being reset.

"Encoder" shows the encoder positions in degrees. If an alt/az scope was pointed north when the DSC was powered up, then encoder mode will read elevation and azimuth, if the scope is also standing reasonably level.

9.11. How is it powered? How long does the battery last?

There is an internal 9-volt transistor battery. The load is 18 to 40mA (NGC-MAX), depending on how bright the display is. I suppose this might depend on the model, too. The maker claims 30 to 50 hours on an alkaline battery. They do last a good long time. There is a "low battery" indicator which would turn on at about 4.5 volts, but in practice, I get "encoder error" messages before that.

Some models have a second connector (serial port) by which external 9- 15 volts DC may be supplied. This does not require the internal battery to be removed; the two supplies are in parallel with diodes to prevent back-circuits. It does not recharge the internal battery.

9.12. How accurately SHOULD the mount be constructed?

The brief answer is, as accurately as you'd like the DSCs to operate.For an equatorial mount, there must be little flexure; the RA axis must be perpendicular to

the dec axis, which in turn must be perpendicular to the optical axis of the tube.

For an alt/az mount, the ground board must be rigid, the azimuth bearing surface must be flat, dent-free and stiff; and the side bearings must be the identical height, that is, the elevation and azimuth axes must be accurately perpendicular. In addition, the optical axis of the tube must be perpendicular to the elevation axis. There is a terrible irony here: the Dobsonian mount works precisely because its kinematically stable design does NOT require that it be accurately constructed!

9.13. How accurately should encoders be installed?

Again, the short answer is, as accurately as you'd like the DSCs to operate. One can't do the job with a hand-held drill. OTOH, careful work with a modest lathe and drill press is quite sufficient, especially if performed by a modest machinist. Most astronomy clubs have such a person.

Best accuracy is obtained with high-resolution encoders. Standard encoders have 2048 steps per revolution, and high-res type has 4000.One can also use gears to provide greater resolution, but see below.

If the encoder is connected directly to a shaft, the hole in the shaft must not be oversize. It must be straight, well centered, and parallel to the axis. The body of the encoder must be held so that it cannot rotate with the shaft. If it is connected by gears, the shafts must be parallel, and there must be no backlash.

Encoders are not especially delicate, but they do not like to be bent.They require very little torque, and rotate continuously. The setscrew should not deform the shaft. The 4-wire connector should be looped so it does not pull on the encoder. They may be mounted such that the shaft is stationary, with the body moving, or the usual way;the direction is set in the DSCs' setup option.

In an alt/az mount, the azimuth encoder is typically mounted atop the center bolt. In this case, the bolt must be nicely perpendicular to the ground board, and the comments about shaft mounting (above) apply. If the rocker box has any side play, it will be nearly impossible to avoid some runout. This can be reduced by using a very long lever arm to hold the body of the encoder.

Both side bearings must be round (especially the one with the encoder), the center must be carefully located, and the encoder shaft parallel to the elevation axis. Any runout There will cause serious inaccuracies when moving across the sky.

9.14. How accurately MUST the mount be constructed?

Please don't feel that only a million dollar mount can be equipped with DSCs. My 1972 Optical Craftsman (German) mount works very well,even with about 0.5 degrees of error if I shift the mounting and return to an object. This was the economy model! A machinist friend helped me drill the holes for the encoder shafts.

I used UGMA grade 10 precision gears to step up the dec shaft speed. The designer of the DSCs was amazed at that, and admitted that he used UGMA 4 with adequate results. I don't know how to calculate how much more accuracy I might be getting from my expensive gears.

My alt/az mount, crafted of wood in my shop with only hand tools, carries a 108mm f/4 scope, and *always* puts an object in a low-power field. OTOH, if I re-collimate the scope, I must also re-position the vertical mark. I usually re-align after moving far across the sky.

If the mounting is less than perfect, it means that you will need tore-align more often. But if the mount is *really* sloppy, it probably will not be satisfactory.

9.15. Can I connect the DSCs to my own computer?

Yes, for some models. The NGC-MAX, and probably others,has a serial port that may be used with an external computer, so that the screen shows a dynamic star map, identifies objects, etc.

But the attached computer must take over ALL functions, including the prompting for "level me," pointing at particular alignment stars,guiding, calculating the conversions for RA and Dec, etc. I understand The_Sky, from Software Bisque, does all this, but I have not seen it in use nor heard from a live user.

The port is a modular telephone connector (RJ11). It has four wires:B+, data in, data out, and ground. External to the NGC-MAX, the cable must route DTR back to the attached computer as DSR, CD, and/or CTS,as needed by the attached computer. The 4th wire is +Battery, a 9 to 15 volt external power supply, which does not charge the internal battery. It is not necessary to remove the internal battery,

When the NGC-MAX is operating in "BOX" mode, it blanks its own display, and does nothing but pass the shaft encoders' values over the serial port. It multiplies them by the encoder ratios (the latter set in the NGC-MAX setup function), and scales them such that 00000 is the position at power-on, and 32767 is just under 1 rotation.

Communication is at 9600,8,N,1. When the NGC-MAX powers on, it sends a hello message such as "V2.94". When the attached computer sends a character (the sample program uses "Q" but anything seems to work) down the port; and the NGC-MAX replies with 13 characters of the format "+00000t+00000" where the "t" is ASCII 9, and the 00000s are the two encoder values.

I don't use this facility, but I'm too curious not to have tried it.I used my modem program to supply the computer side. I use the NGC-MAX whenever I'm

doing general observing, and I like it very well.But I don't have a portable computer to use with it, and don't too much see the need. OTOH, if I fell into a laptop, I'd surely want to try connecting them.

10. Why Should I Start With Binoculars?

The quick answer is because you already have them, so you do not have to spend any money. Certainly going right out and buying the Fujinon 25x150 Astronomical Binocular ($11,000 list price) would be a pretty stupid thing to do, no matter how good the binoculars are.

You should also avoid the quick-focus binoculars, as they are easy to de-focus as well.

The remainder of this section was written by Paul Zander.

Based on my experience, I suggest that you start with a pair of 7x50 binoculars. This is the most popular size and hence good ones are available from many stores, even some of the discounters. Be sure to get ones that have anti-reflection coatings on the mirrors and lens. If you wear eyeglasses, you may be able to find binoculars which can focus without them (unless you have significant astigmatism). Make sure the image is sharp at the center and edges at the same time.

"7x" is the magnification. Most people can hand hold these without needing to bother with tripods, etc. The "50" means 50mm (~2 inch) objectives (aperture). This gives light gathering ability similar to many small telescopes. Many advanced star gazers regularly use binoculars to either locate items to focus telescopes on, or just for the wider field of view.

When trying to view near the zenith, use a reclining lawn lounger: you can lie back and support your arms on the chair, giving a steadier view. You also will not get a crick in your neck.

You might also use a plastic pad to lie on.

10.1. How Do I Hold Binoculars?
This section was written by Jay Freeman.

If you don't have a tripod (and tripods are sometimes a little clumsy, and are often difficult to use when the binocular is pointing near the zenith), it is important to know how to hold a binocular correctly to achieve maximum steadiness.

The way most people tend to hold a binocular is with one hand on each side of the middle of the body-roughly where the prisms are in a conventional 7x50, say, so that the left hand is directly to the left of the center of gravity of the instrument and the right hand is directly opposite it, to the right of the center of gravity.

For most people, there is a better position. Imagine that you are holding the binocular to your eyes, with your hands positioned as just described. Now, slide your hands along the body of the instrument,toward your face, until only your pinky and ring fingers are curled around the back end of the binocular body. In this position, the binocular feels a little nose-heavy, because you are supporting it behind its center of gravity.

Now curl each thumb up as if you were making a fist, and flex your hands so that the second bone in from the tip of your thumbs are pressed up against your cheekbones (counting the bone in the part of your thumb where the thumbnail is, as the first bone). This makes a quite solid structural connection between the body of the binocular, through your hands and thumbs, to your face, and markedly improves how steadily you can hold the instrument. Similarly, curl the first and middle fingers of each hand around the corresponding binocular eyepiece, to provide a little more structural connection (and perhaps also some protection from stray light). In this position, your hands are not far from where they would be if you brought them to your face to block out stray reflections while peering through a store window at night.

For most people, this position leads to markedly steadier viewing, but if the binocular is especially long and heavy (say, a 10x70 or an 11x80), the out-of-balance position can be quite tiring. In that case, move *one* hand out to the objective end of its side of the binocular, so that you are supporting the instrument on opposite sides of its center of gravity, but with some structural connection between it and your face; namely, the other hand. When the hand way out there gets tired-just switch hands.

For each person, there is a limit to how heavy and / or how powerful a binocular can be, before there is no way for that person to hold it steady enough. I am an averaged-sized adult male in reasonable physical condition, and I find I can hold a 10x70 (Orion's) steadily enough to use indefinitely on astronomical objects. But I have an old Celestron 11x80, that doesn't look much bigger or heavier than the 10x70,that I can only use for a few minutes before my arms get tired. As a 12-year old I am sure I could have used a 7x50 indefinitely with no problem, but at a younger age I might have had difficulty using one continuously. Your experience may vary with your strength, size and condition. Try before you buy, if at all possible.

10.2. What Are Some Eye Relief Figures?

If you need to wear eyeglasses while looking through binoculars (presumably you have astigmatism, but if you require many diopters of correction you might need to as well) you need reasonably good eye relief. Dana Bunner contributes the following table:

Model	Advertised ER	Measured ER
Bausch & Lomb 7x26 Custom	16	15
Celestron 10x50 Pro	15	10

Celestron 7x42 Ultima	23	19	
Celestron 7x50 Ultima	20	16	
Celestron 10x50 Ultima	19	17	
Celestron 8x56 Ultima	21	11	
Fujinon 8x40 BFL	19	17	
Fujinon 7x50 FMT-SX	23	20	
Fujinon 10x70 FMT-SX	19	17	
Minolta 7x50 Standard	18	16	
Minolta 10x50 Standard	?	9	(FYI)
Minolta 10x50 XL	18	16	
Nikon 8x30E Criterion	13	13	
Nikon 7x50 Windjammer	16	16	
Optolyth 10x40 Touring	13	12	
Pentax 8x24 UCF	13	8	
Pentax 7x35 PCF	14	9	
Pentax 7x50 PCF	20	10	
Swift 8x25 Micron	13	11	
Zeiss 7x42 B/GA T Dialyt	19	18	
Zeiss 20x60S	?	14	(FYI)

11. What Books and Star Charts Are Recommended?

If you don't know the constellations, you might want a book that will help you learn them. A "fun" book for those just learning the stars is *The Stars, A New Way of Seeing Them* by H. Rey, which presents a non-orthodox way of drawing the constellations so they are easier to visualize.

You will probably want a beginner's guide, such as the book by Sherrod mentioned above. Sky Publishing has some introductory materials which would probably be as useful, which you get for free when you subscribe to Sky and Telescope.

Petersen's Field Guide to the Stars and Planets comes highly recommended. It is very inexpensive ($13), small and handy to use at the telescope. It has a good discussion about stars, planets, nebulae, and galaxies; and has a very complete albeit small-scale star chart, along with a the usual tables. It hasm long lists of deep-sky objects for each area of the sky.

You will need a bigger star chart than is included in Petersen's. *Try Sky Atlas 2000.0*, by Wil Tirion. The field edition, which has white stars on a black field, is probably more useful than the desk guide. It is also printed on heavier paper, so is more resistant to dew and the rigors of the night. For beginners, buying Uranometria 2000.0 is probably a mistake. Yes, it is the "best" star chart, but the scale is impossibly small- when the Orion constellation takes up four separate pages it is really hard to use for beginners.

Burnham's Celestial Handbook ($36). This three volume set is billed as "An Observer's Guide to the Universe Beyond the Solar System" rather all-encompassing claim, which it manages to live up too. Information on every item of interest you can think of: galaxies, double stars (optical and binary),variable stars, nebulae, etc. More information than you could use in a lifetime. I consider this a necessity.

Sky and Telescope's 100 Best Deep Sky Objects. About $5, which is kind of expensive for a list, but it sure makes it easier to figure out what to look at when you are just beginning. The items are sorted by Right Ascension, which makes it real easy to figure out which ones are currently up.

All the materials listed are available from:

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Sky Publishing Corporation
P.O. Box 9111
Belmont, MA 02178-9918 USA
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Their catalog is free.

11.1. What About Computer Programs?

There are to many types of computer programs that I can NOT review, as they do not run on my machine. I think there should be a FAQ just for all the computer programs.

12. About this FAQ


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*-----------------------------------------------------------*
|Slc.Dennis Bishop   |Black Hole BBS |This FAQ now is Home  |
|470 20th West #23   |805-256-9065   |on an Atari Falcon030 |
|Rosamond,Ca.93560   |9pm to 9am PST |and Atari TT/030.     |
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|Bishop Telescope Fund   | Akumaizer Cattery  | E-mail List Owner   |
|470 20th ST West #23    | Japanese  Bobtails | Dahlia-net          |
|Rosamond,Ca.93560       | Home Rasied JBT's  | Canna-net           |
|starlord@ptw.com        |                    | Astronomy/SIAR-L    |
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64/9/5 (Item 3 from file: 47)
DIALOG(R)File 47:Gale Group Magazine DB(TM)

04554278 SUPPLIER NUMBER: 18548034
Voyager: a motorized binocular chair. (**Telescope** Making)
Schmidt, Wayne M.
Sky & Telescope, v92, n1, p86(3)
July, 1996
ISSN: 0037-6604 LANGUAGE: English RECORD TYPE: Fulltext; Abstract
WORD COUNT: 1117 LINE COUNT: 00088

ABSTRACT: An amateur astronomer created a giant binocular **telescope** **mounted** on a rotating chair that would allow him to make sweeping views of the sky. The chair is **mounted** on a ball-**bearing** plate supported by a disk, with altitude casters attached to move the seat to an inclined position.

TEXT:

The universe comes alive! The only drawback is that once you experience a deep-space binocular view you'll never be satisfied with a single-eye **telescope** again.

After using a 13-inch Newtonian **telescope** for five years my enthusiasm for astronomy began to wane. Locating difficult celestial objects was still satisfying, but the fun was missing. Fatigue from viewing with only one eye, fighting the cold, and stretching to reach the eyepiece were my chief complaints.

My solution to this dilemma is pictured here. Since all the shortcomings of the previous **telescope** related to discomfort, the answer was to attach the optics to a chair that I could ride. Motors would drive the chair, allowing me to "fly" among the stars without stretching or twisting my neck. Adding a second **telescope** to make a large binocular would eliminate eyestrain and create a richer, almost stereoscopic, view of the sky. Finally, enclosing the sides and top of the chair would provide protection against wind, cold, and stray light.

The base, rocker box, chair, and yoke holding the dual **telescopes** are made of 1/2-inch plywood. Critical areas are reinforced with 2-inch-thick lumber. In a departure from the popular **Dobsonian**-type **mounting**, the altitude **bearings** of my instrument are inverted metal casters. While these casters have more drag than Teflon **bearings**, the small diameter of their axles converts this drag into an insignificant amount of torque.

The chair rotates in azimuth on a 12-inch ball-**bearing** plate of the lazy-Susan type, with additional outlying casters for added stability. Direct-current motors drive the chair in both altitude and azimuth at fast and slow speeds. The yoke holding the **telescopes** is also motorized. It moves up and down as well as back and forth, making getting into or out of the chair easy. This movable yoke also enables fine **adjustment** in the eyepiece position to maximize viewing comfort. All motors are rechargeable electric drills with the handles cut off. Controls are located on the chair's armrests.

Contoured cushions up to five inches thick line the chair. The sides of the chair block the wind, further adding to the operator's comfort. An electrically heated vest keeps me warm, even in freezing temperatures.

The **telescopes** are 8-inch f/8 Newtonians. These are the first mirrors and **telescopes** I have made. The hardest part was getting the two focal lengths to match within the 1 percent tolerance normally recommended for binoculars. Both mirrors have smooth figures and good edges. Each one passes a six-point Millies-Lacroix test for a diffraction-limited paraboloidal figure (S&T: February 1976, page 127).

These primary mirrors are secured to their cells with foam **mounting** tape, which eliminates the diffraction spikes that holding clips would produce. Fifty-millimeter Plossl eyepieces provide 32.5x and a 1.4 (degrees) field of view. I chose long-focus oculars not only for low power but also for long eye relief, because I wear glasses when observing.

The exit pupils of the Plossls, calculated by dividing the **telescope** aperture by the magnification, work out to be 6.25 mm. That's almost exactly the same as the fully expanded pupils of my eyes at night.

Secondary mirrors with a 1 1/2-inch minor axis provide 100 percent illumination across a 20-arcminute field of view. The illumination drops to 94 percent at 30 arcminutes, which is still quite acceptable. If the primary mirrors had been any shorter in focal length I would have needed larger diagonals, which would block more light and impair image quality with diffraction effects. They are held in place by three pairs of 0.008-inch-diameter wires rather than the usual sheet-metal vanes that are typically 0.020 inch thick. Such thin wires, again, minimize contrast losses due to diffraction.

The **telescope** bodies are cardboard tubes of the type sold at hardware stores for making concrete forms. Their inside surfaces are painted flat black, and the tubes are fully baffled with black velvet in critical areas. The eyepieces are **mounted** in drawtube focusers that also house 1 3/4-inch tertiary mirrors. All mirrors have enhanced aluminum coatings for maximum reflectivity. One **telescope** is carried on an **adjustable** rack controlled by push-pull screws, enabling the operator to align the images from the **telescopes** while sitting in the chair.

Adlerblick 7x50 binoculars serve as a finderscope. Their 7 (degrees) field and erect image make locating objects fast and easy. An **adjustable** magnetized chart holder is **mounted** just below the binoculars. A flat-black cover over the **telescopes** creates a miniature observatory for the operator, allowing full dark adaptation to be achieved and maintained.

Power for the chair is provided by a 6-volt, 140-ampere-hour, deep-discharge battery. It has enough capacity for five full nights of observing, if the heated vest isn't used. The vest cuts the battery life in half.

Using this chair is an unforgettable experience. Observing is so easy that I can relax completely and concentrate better. As a result I can see much finer details than most people would imagine possible with an 8-inch **telescope**. One surprise is the image enhancement produced by a headrest, which ensures that the observer's eyes remain in a fixed position relative to the eyepieces. I feel that this improves the quality of the view almost as much as going from a monocular **telescope** to binoculars.

Binocular **telescopes** really must be tried to be appreciated. The degree to which images jump to life cannot be explained! The only drawback is that once you experience a deep-space binocular view you'll never be satisfied with a single-eye **telescope** again.

While the **telescopes** have only 8-inch mirrors, I suspect they offer the same outstanding views as a 10- to 12-inch, thanks to the comfort of the chair and the advantages of binocular viewing. The Orion Nebula is a great glowing cloud, full of bright undulations and rifts. The Lagoon, Swan, and Trifid leap from the eyepieces with indescribable splendor, as do open clusters and large galaxies. With my Voyager the universe comes alive, inviting exploration.

WAYNE M. SCHMIDT 1148 East Ave., J-5 Lancaster, CA 93535

A 45-year-old retired plasma-rocket-engine research engineer, Schmidt divides his time between astronomy, gardening, and cooking for his wife and two children. He is a member of the Antelope Valley Astronomy Club.

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Astronomical Equipment for Amateurs

Martin Mobberley (Springer-Verlag, 1999). 256 pages. 1-85233-019-8. $39.95, paperbound.

Amateur Telescope Making

Stephen F. Tonkin, ed. (Springer-Verlag, 1999). 259 pages. ISBN 1-85233- 000-7. $42.00, paperbound. Both available from Sky Publishing.

Review by Richard Berry

There will never be enough books about telescopes and telescope making to satisfy amateur astronomers. Each year dozens (if not hundreds) of new ideas and new products appear, enriching amateur astronomy. Martin Mobberley and Stephen Tonkin have each added a worthy contribution to the collective wisdom of amateur astronomy, with books devoted to astronomical equipment and telescope making. Both are part of Springer's continuing Practical Astronomy series.

In philosophy, however, the two books could not be more different. Mobberley's contribution is steadfastly devoted to off-the-shelf telescopes and accessories. In today's rapidly changing marketplace, just keeping up with new products is a daunting task that Mobberley accomplishes quite well. In a sharply contrasting approach to amateur astronomy, Tonkin has assembled a potpourri of excellent do-it-yourself projects, ranging from small refractors and simple rich-field telescopes to large instruments with tilted-component optics and a high-performance, home-built, computer-controlled telescope.

Fifty years hence, Mobberley's detailed survey of "turn-of-the-century" commercial telescopes, eyepieces, **mountings**, CCD cameras, and video systems will undoubtedly seem quaint but will nonetheless offer fascinating insight into how an experienced British amateur circa 1998 viewed his hobby. It is evident from the pictures in the book that Mobberley began his career in amateur astronomy as a telescope maker and gradually became a telescope buyer. With a substantial investment in his backyard telescopes and considerable experience in film, CCD, and video imaging, Mobberley was indeed well equipped to write his book.

Mobberley is clearly fascinated and impressed with the technology of today's telescopes and **mountings**. In the third chapter, for example, he gives a tear-down tour of the drive system of a 12-inch Schmidt-Cassegrain. He explains how periodic-error correction reduces the inherent large gear errors to tolerable levels, and marvels at the tiny motors that move the telescope. In the second half of the book, Mobberley details commercial film and CCD cameras, and the software and hardware needed to support their use. Although clearly most familiar with the Starlight Xpress product line, Mobberley describes the SBIG ST-7 in some detail and touches on the many other commercial CCD cameras on the market.

Because Mobberley's book is intended as a comprehensive survey of commercially made equipment for the modern amateur astronomer, novices may find the book intimidating. Perhaps inadvertently, the text leaves the impression that doing astronomy requires tens of thousands of dollars worth of high-tech equipment. The author's 49-centimeter f/4.5 Newtonian, 36-cm Cassegrain-Newtonian convertible, Epsilon 160 f/3.3 hyperbolic astrograph, and the plethora of film, CCD, and video cameras pictured in the book do little to suggest otherwise. The volume will undoubtedly find a wider and more appreciative readership if in the next edition the publisher allows Mobberley to devote more space to telescopes and equipment suitable for beginners and amateurs of modest means.

The strength of Mobberley's book is that he has assembled many

innovative ideas that have appeared in the periodical literature in the last two decades and integrated them in a single text for the equipment-buying amateur. Innovations such as the **Poncet platform**, jumbo binoculars, altazimuth field derotators, Kron-Cousins photometric filters, and diffraction focusing have finally found a place in the literature of off- the-shelf amateur astronomy.

In contrast to Mobberley's emphasis on commercial products, Stephen Tonkin's book focuses on do-it-yourself projects. All 15 contributions to this book were written by "brand-name" amateur telescope makers. The projects are divided into four categories: Shoestring Telescopes, Specialized Telescopes, **Mounts**, and Astrophotography (which includes CCD imaging).

The "shoestring" telescopes are all low-budget productions: Steven Lee's 6-inch f/5 rich-field, Gilbert Stacy's $400 "skinflint" 15.5-inch **Dobsonian**, and Tonkin's 80-millimeter rich-field refractor. These projects serve a vital role in reassuring the newcomer that the entrance cost to amateur astronomy is far below the multithousand-dollar level and that telescopes are well within the skills of any basement builder.

Specialized telescopes include a high-performance 6-inch f/9 planetary reflector by Gary Seronik, a collapsible folded refractor by Klaus-Peter Schroder, a compact Wright camera by Bratislav Curcic, an overgrown Astroscan-like ball scope by Lee, and an outstanding optical project: a 12-inch f/20 four-element unobstructed schiefspiegler by Terry Platt. As a telescope maker, I found the level of detail in these project descriptions entirely adequate, though naturally one always wants to see more.

"**Mounts**" was an excellent choice for a section on advanced topics, since garden-variety commercial telescope **mounts** are often marginal for CCD imaging, and most home-built telescopes would benefit from more accurate tracking. Chuck Shaw's chapter on conical-**bearing equatorial platforms** gives detailed instructions for using simple jigs and hand tools to form the difficult conic **contours**. Mel Bartels's description of his computer- driven altazimuth **mounting** is a strikingly clear introduction to a sophisticated hardware/software project that Bartels offers freely on his Web page. The simple parallelogram binocular **mounting** by Scott Wilson counterbalances these weighty projects with a very handy **mounting** that any binocular observer will appreciate.

The astrophotography section is a mix of basic camera trackers (a tangent-compensated barndoor **mounting** by Tonkin and a simple wooden "skypod" tracker by Euan Mason) and Al Kelly's description of building the Cookbook camera. As one of the authors of The CCD Camera Cookbook, I can only say how pleased I am with the excellent images that Al has taken with his camera. The final chapter is David Johnson's time-proven design for a 230-volt, 50-hertz variable-frequency oscillator for synchronous motors.

Both books will appeal strongly to midlevel amateur astronomers, whether they are equipment buyers or builders. Novices should find much to marvel at, and advanced amateurs will appreciate the useful and timely insights into the current technology of telescopes and sensors. Both are worthy additions to the ever-growing literature of telescopes and telescope making.

Richard Berry is the author of Build Your Own Telescope, The **Dobsonian** Telescope (with David Kriege), and a forthcoming book on CCD imaging and image processing.

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The Sky's the Limit.
Duntemann, J.
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ABSTRACT: Spectrum HoloByte's TellStar and Compress's Journey to the Stars astronomy programs give micro users a taste of the magic of Zeiss planetarium projectors. TellStar is the more sophisticated of the two packages. While Journey to the Stars will prove to be old hat for amateur astronomers, TellStar will prove to be absolutely indispensible for planning planetary observation and photography. Journey to the Stars, meanwhile, can teach the user a bit about the stars and the constellations; it includes a table of 1,400 stars. Most important of all, both programs are fun. TellStar costs $79.95 ($129.95 for the 8087-compatible version). Journey to the Stars costs $60. Screen displays are included.

TEXT:

Ever since I met the big Zeiss planetarium projector at Chicago's Adler Planetarium, the power of the planetarium concept has fascinated me. It's a time machine with its eye turned skyward: A few taps at the controls and you can see the night skies as they looked the day you were born--or the day Christ was born. Tap another command, and the stars appear as you might see them in the daytime if the sun could be dimmed to a faint ruddy disk.

The Zeiss planetarium projectors were originally analog computers, relying on a combination of mechanical setting circles and precision motors to perform their magic. Like everything else, planateriums have recently gone digital. Most projectors are now controlled by computers, typically DEC PDP-8 or PDP-11 machines. No precision motor can calculate as accurately (or as fast) as a good floating-point math package.

It should come as no surprise that you can work some of that planetarium magic in your living room on the screen of your PC's monitor. TellStar from Spectrum HoloByte, Inc., and Journey to the Stars from Compress, are two new astronomy programs that can give you a taste of that magic. I had originally intended to compare the two, but they turned out to be so different in their approaches as to be nearly complementary.

TellStar: The Software Ephemeris

TellStar has been around for several years for the Apple II and has recently been converted for the IBM PC. It has several uses, but it functions best as a fast and very accurate software ephemeris.

An ephemeris is a table of values to be used in calculating the positions of the sun, moon, planets, and planetary satellites at a given time and from a given place on Earth. The U. S. Naval Observatory publishes an ephemeris each year called The Astronomical Almanac. Inexpensive and a superb-quality hardback book, The Astronomical Almanac is really just a collection of data; to find an object with its help requires a certain amount of work on your part, and occasionally some frightening calculations.

While not as complete as The Astronomical Almanac, Tellstar does all the work, as a good computer program should. Basically, you tell TellStar where you are and when, and zap, TellStar shows you what's out there.

TellStar has tables for the sun, the moon, and all nine planets in the solar system. It can display 247 of the brightest stars and all 110 Messier objects (a collection of the brightest star clusters, nebulae, and galaxies). It can show you the stars for any Earth location at any time all the way back to the year A.D. 0 and on into the future up to the year 3000. (To its credit, the program warns that its greatest accuracy lies in the 1980 to 2000 range. Knowing how these calculations work, I would say that any date before 1600 or after A.D. 2400 would be so distorted by cumulative inaccuracies as to be misleading.)

Setting up TellStar

TellStar originated in the garage days of microcomputer software, which in this case means sparse, technically oriented documentation and severe, non-nonsense, command-driven screens. Its 72-page reference manual is daisywheel-printed and contains no illustrations. It has no index, and at least half of it consists of tables of star and Messier object positions.

The upshot is that you must read the entire manual carefully before you attempt to install or run TellStar. The software, while competently designed, is not self-explanatory.

TellStar's greatest drawback is that it is copy protected, and there is no provision for backup copies. Spectrum HoloByte will replace a defective diskette within 10 days of purchase; thereafter the company will replace defective disks for $20, at its option, if you return the original disk. This means that the company expects you to run the distribution diskette on a day-to-day basis, which I consider pure madness for anything but video games. Worse, the copy of TellStar I received for review would not work reliably on my system. About half the time I ran it, I got read errors that brought the program down. It worked reliably only after I used Copy II-PC to move the program (in admitted violation of the license agreement) to one of my own disks.

TellStar's disk maintains a "standard" location for observing. Generally you enter the **latitude** and longitude of your own location. To help you, the manual's appendix holds a table of the coordinates of about 100 major cities. Although Rochester, where I live, is not among them, I found its coordinates in the Encyclopedia Britannica. Many American atlases and gazetteers also contain the **latitudes** and longitudes of American cities.

You must also enter the time of observation. When booting, TellStar reads your system clock and asks if you wish to use that time in calculating the positions of the stars and planets. Alternatively, you can enter any date and time you like. One caution--enter the entire year, including the century! The first tie through I typed in 84 for the year--and I got the sky for the year A.D. 84.

Putting the Skies on the Screen

TellStar must recalculate the positions for about 260 different objects each time you change either the observing location or the observing time. On an IBM PC, the calculations take a minimum of about 90 seconds. The further away from the current date you go, the longer it takes--up to several minutes for A.D. 84.

The program courteously indicates the progress of its calculations by printing periods across the scree as it goes. This reassures nervous types that the machine has not slipped a bit and gone off into the fifth dimension.

Once the calculations are complete, you have two choices: display a simulation of the sky or use the calculated positions for further calculations.

Casual observers will almost always choose the display. TellStar can display nine views of the heavens, one looking toward each of the eight major points of the compass and one looking toward the zenith. The PC's cursor control keys move you instantly from one to another.

Stars are represented by points or crosses, planets by small white disks (except for Saturn, which is a small white disk with rings), the sun by a larger magenta disk, and the moon by a white disk that displays the current phase.

The star display in TellStar is relatively sparse. Two hundred forty-seven stars aren't really that many, and they have been chosen to give good outlines of the major constellations. All of the zodiac appears on screen the better to orient you for spotting the fainter planets. Away from the zodiac, displayed stars thin out considerably.

This is not altogether a bad thing, considering the small area of scree available for plotting stars. The PC's graphics screen is a fairly coarse medium for displaying hundreds of tiny objects. Raising the total to about 350 stars would add significantly to TellStar's usefulness, but any more than that would crowd the screen.

Somewhere West of Zubenelgenubi

TellStar displays a number of commands at the bottom of the screen. By far the most interesting is the I (identify) command. Pressing the I key

brings up a small crosshair cursor on the screen. The cursor control keys move the crosshair around the star field. When you have the crosshair centered over an object and press the space bar, the program identifies the object by name and gives its magnitude, rise and set times, and its position in **equatorial** coordinates (right ascension and declination) and horizontal or altazimuth coordinates (heading and elevation.)

This feature is absolutely necessary for telling the planets from Messier objects. It is less useful for the stars for the curious reason that it gives the stars' ancient (usually Arabic) names rather than using the modern astronomical nomenclature that consists of the constellation in which the star appears plus a numeric or Greek letter identifier. For example, I placed the crosshair on Alpha Librae and was told I had chosen Zubenelgenubi. Moving over to Beta Librae, I found that TellStar knew it only as Zubeneschemali. None of my friends had aver heard of Zubenelgenubi, though they guessed that it may have been where Obiwan Kenobi came from.

All humor aside, this is a serious deficiency. TellStar's identify function works the other way as well; if you type in "Zubenelgenubi" after the L (Locate) command, TellStar places a flashing crosshair over Alpha Librae. If you type "Alpha Librae" instead, TellStar insists that no such object is in its tables.

Glancing through the appendixes, I noted that the vast majority of the stars in TellStar's tables were named things like Unuk, Wasat, Rutilicus, Alkaluropis, and Zosma, without even a paper cross-reference to their more familiar names. While Zubenelgenubi is a whacky and romantic thing to call a star, it is not what 99.44 percent of amateur astronomers call Alpha Librae. So at least as far as stars are concerned, TellStar's identify function is of little practical use.

Looking for Mercury

On the other hand, TellStar really shines when looking for planets. Finding Mercury in the sky is an unholy hassle, especially in a city where your horizon is dirty and cluttered. Mercury, while a fairly bright planet, is always close to the sun and never in an especially dark sky. Finding it is rough unless you know exactly where to look.

I knew that Mercury is a morning star for the first half of January. I also knew that, where I live, the sun rises about 7:15 a.m. at this time of year. So I requested a display of the southeastern sky at 7 a.m., and there was Mercury, just a bit east of Antares, in Scorpius. The display showed it fairly close to the horizon but quite bright, and it gave me a good idea where to look based on the position of familiar costellations.

On a cold January morning I hopped into my car in search of a flat horizon. Looking southeast over a nearby cornfield, I saw against pink dawnlight a bright star to one side of Antares. It was no longer anything like night, and all but the brightest of the real stars were dimming out. Had i gone earlier for darkness, Mercury would have been hidden by trees along the horizon. Since TellStar told me where to look, I could find it even in a mottled and pinkish sky.

The TellStar Utilities

In addition to its display function, TellStar performs a number of nondisplay functions using the star and planet tables. It can give you the position, magnitude, and rise and set times for any solar system object without having to calculate positions for all 247 stars. Another TellStar utility converts **equatorial** to altazimuth coordinates and back again. A more arcane utility provides precision adjustments from epoch 1950 coordinate tables to current coordinates. This allows you to use charts and star catalogs drawn up for epoch 1950 to find objects not included in TellStar's tables. The Earth's **equatorial** wobble renders star charts inaccurate over a period of years, but tables are generally issued for "epochs" only every 50 years. You can either do the interpolation yourself on paper or let the TellStar do it--I'm for the computer every time.

TellStar can also convert between ecliptic and **equatorial** coordinates. Ecliptic coordinates view the universe from the sun's perspective rather than the Earth's. You're unlikely to use them unless you are very deep into your astronomy.

A Lighter Journey to the Stars

For all that TellStar can do, it expects a fair amount of sophistication from its users. It shows and it tells; it does not explain. With some delight, I can report that Journey to the Stars can do what TellStar can't: teach you a little bit about the stars and the

constellations. It has a table of 1,400 stars, and it displays them on your computer's screen. It does not deal at all with the sun, moon, or planets, nor does it offer rise times, set times, or coordinates for the stars.

What Journey excels at is teaching. Journey can take a beginning observer and explain the fundamental concepts governing the apaprent motions of the stars from the Earth. It teaches the names of the stars and the constellations and how to find them in the skies.

To install Journey to the Stars, you must run a program that enables or disables color (for using a monochrome monitor) and enables or disables sound. The sound is used only to accompany the pointer for the Find That Star drill. It is amusing the first few times you hear it, but I was very glad I could turn it off.

Unlike virtually every other educational program I have reviewed, Journey includes a tutorial program, JSTUTOR, that teaches you how to use the Journey to the Stars program itself, explaining its commands and the various courses (called "journeys") it offers. Once you run JSTUTOR, you don't need to flip through the manual very much. JSTUTOR is beautifully designed and can be appreciated by fairly young children. I would not hesitate at all to put in the hands of a bright 8-year-old.

You run the main program by typing JSTARS. It is divided into ten journeys, each of which is a mini-course in some aspect of backyard astronomy. Journey 1 is JSTUTOR, which may be run from within Journey's main menu. Journeys 2 and 3 are the real meat of the program: Constellations and Bright Stars. Journeys 4 and 5 present the stars for the northern and southern hemispheres. Journeys 6 through 9 present the stars as they change through the four seasons, winter, spring, summer, and fall. Journey 10 explains how to locate stars and constellations through the use of right ascension and declination coordinates.

No Lines

I remember being very young and taking my copy of The Golden Book of Astronomy out in the backyard and trying to find Leo the Lion. Unlike the crisp charts in the book, the skies showed no helpful lines between the stars. I was able to find Leo after awhile, but I kept wishing that God would just turn on the lines for a few seconds so I could get my **bearings**; after that I would gladly muddle through on my own.

Journey to the Stars has 48 constellations in its tables. These are only about half of the constellations actually in the sky, but many constellations are so faint that they contain no recognizable patterns. All of the bright and easy constellations are here, including the 12 constellations of the zodiac.

You can display any of these 48 constellations on the screen. No lines connect the stars, but if you cannot bring yourself to see the water snake in Hydra (I confess that one escapes me as well), pressing the Enter key projects a bare-bones outline of the major figure between the stars. This is easy enough for water snakes, but the representation of Libra suggests nothing of scales, and the Big Bear seems more a collapsed cubistic Pac-Man.

Journey also includes a drill/game called Name That Constellation. The program picks a constellation at random and displays it without lines. You try to recognize the pattern on your own and type the name into the screen. The program keeps **track** of how many you've gotten correct, and when you get one wrong it jogs your memory by drawing the telltale lines between the stars and telling you the correct name.

Curses, Zubenelgenubied Again!

The Bright Stars journey shows you how to find 42 of the brightest stars. If you choose, it will then drill you by playing Name That Star: Journey draws a circle around a star on a starfield (no constellation lines to help here), and you must enter the name of the star.

Unfortunately, Name That Star has a familiar problem: you have to type in the star's ancient name. The Arabs said Alnilam; I say Epsilon Orionis; Journey expects Alnilam. Much to its credit, Journey always gives the modern designation alongside a star's ancient name; but when push comes to shove and the drill starts, it accepts only the ancient name.

You can also find that star when displaying the seasonal star charts. For this drill, Journey cheerily commands, "Find Cursa!" You then steer a little pionter (called a UFO--arrgh!) over to Cursa with the arrow keys and press the Ins key to register your choice. If you have never heard of Cursa (join the club--it is not one of the 42 brightest stars from the previous

drill), Journey moves the pionter to the proper position and corrects you: "Sorry, you picked Zaurac. Here is Cursa."

I scored badly in this drill, having been asked to locate stars with names such as Albena, Kochab, and Shedir. Finally I was told, "Locate Zubenelschemali!" I figured, no problem--but when I moved the UFO confidently to the furthest corner of the screen, I was scolded: "Sorry, you picked Zubenelgenubi. Here is Zubenelschemali."

I'll get it right one of these days.

Complaints

Considering what passes for software these days, both of these programs get very high marks. Both are remarkably bug-free. At one point, TellStar scrolls up the entire graphics screen one line after you enter a text response, which loses part of the star display off the top of the screen. Journey looks completely clean.

My worst complaint against both programs focuses on their emphasis on ancient names. I built my first telescope at 13 and have a pretty good working knowledge of the skies, but it does not and will not include memorizing hordes of quaint and bizarre names such as Cursa, Zaurac, and Zubenelgenubi. There is a systematic and universally used designation system for the two or three thousand brightest stars. It uses the generic form of the constellation that contains the star and a Greek letter that roughly indicates its magnitude rank within the constellation. Thus, Alpha Orionis is the brightest star in Orion, and so on. For fainter stars, ordinary numbers are used, and the ranking is according to increasing right ascension. Almost everyone uses this system.

To best serve amateur astronomers and other students of the skies, both programs should recognize both the ancient and modern naming systems. I know that it can be done, and I hope that both programs will incorporate the necessary changes in future releases.

TellStar's sky displays are needlessly small and plagued by an irritating distortion toward the top of the screen. Anytime a spherical area is displayed on a plane, there tends to be some distortion, but using a mapmaker trick or two can minimize this. TellStar's projections are Mercatorstyle (you know, like those world maps in which Greenland appears as large as all of South America) I would, however, gladly suffer a reasonable increase in processing time in exchange for a more sophisticated projection that would eliminate much of this distortion.

Journey to the Stars has an overrigid command structure. Once you begin playing Find That Star, you have only two options: continue playing or exit the display to the main menu. Furthermore, once you move the view with the arrow keys from the standard seasonal view, you can no longer play Find That Star. This may be a bug or it may be a feature, but whatever the intention, it would be easy to avoid and should be changed.

However, that's about where it ends. What's most important to emphasize is that these programs are fun. If you are already an amateur astronomer, Journey to the Stars will be old hat, but TellStar will become absolutely indispensible for planning planetary observation and photography. TellStar also provides a tremendous bonus for astronomers who own a **Dobsonian** telescope: It gives, for all objects, altazimuth positions (heading and elevation), which are the only kind of coordinates a **Dobsonian mounting** understands. Odyssey owners, rejoice! Dial-and-find astronomy is within your grasp!

If you are curious about the stars but never took time to learn the lore of the skies, Journey to the Star is an inexpensive and enjoyable way to start. Much more than TellStar, Journey encourages you to "poke around" without making you feel as if you're in way over your head.

And pretty soon, having mastered Journey to the Stars, you'll be out there under the sky pulling on Leo's tail.

Faster, in fact, than you can say "Zubenelgenubi!"

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THE NEXT GENERATION

The NGT-6 equatorial split-ring mount mimics the 200-inch telescope at Palomar Observatory.

Star Trek: The Next Generation brought us a new crew, new technology, and new missions. Now, thanks to Jim's Mobile, Inc. (JMI), of Lakewood, Colorado, the Next Generation Telescope line brings a new crew (intermediate observers) some new technology (an equatorial split-ring mount). The new (observing) missions are up to you.

One-third the size of JMI's venerable NGT-18, the smaller NGT-6 (f/5) holds its own as a next-generation telescope. Its steering mechanism mimics that of the 200-inch Hale telescope at Palomar Observatory in California -- only you can carry it around. Besides, it's undeniably cute.

Hey, cute is good, especially when it's functional. And this Newtonian-style telescope is nearly an ideal instrument. Its aperture is large enough to spot planetary details as well as many distant deep-sky objects.

I borrowed an NGT-6 directly from JMI. The telescope arrived with all of the standard gear included in the $1,200 base price: a 25mm Plossl eyepiece; polar-alignment sight tube; Celestron Starpointer LED-style unity finder; and dual-axis, 9-volt DC clock drive with hand controller. Optional equipment included a black fabric light shroud, motorized focuser, a pair of 1.5-pound counterweights, NGC-microMAX digital setting circles, and the custom tripod mount.

The NGT-6 sits on a split-ring equatorial mount that pivots in declination within a 14.75" drive ring, which rides on a pair of wheels. A clock-driven motor powers one of those wheels, which tracks the instrument in right ascension. If the design sounds familiar, it should; it operates just like the horseshoe-shaped mount drives for many professional telescopes in observatories around the world.

Another feature that the NGT-6 shares with many of the large observatory telescopes is its Serrurier truss arrangement. It's an open-tube design, like many large-aperture Newtonians. But while those larger instruments typically use aluminum pipes for the truss, JMI substitutes composite poles. Made from an amalgamate of one-third fiberglass and two-thirds nylon, the poles span between the primary mirror's tub assembly and the secondary mirror's nose assembly.

Tips and Tubs

Without a tripod, the NGT-6 stands 35 inches tall and weighs 26 pounds. Its compact size makes it easy to carry around. I recommend JMI's optional custom tripod. The tip on each square aluminum leg has a built-in flashing red LED; each is also capped with a protective rubber foot. This solid metal tripod not only features a large, triangular plate that supports the telescope's base and holds extra eyepieces, but it also holds the drive's hand controller as well as the display unit for the

digital setting circles.

The NGT-6 arrived at my door in perfect collimation, which says something about the quality of the mirror's cell and the instrument's overall construction. If you need to adjust collimation, turn three bolts at the bottom of the mirror tub.

Speaking of the mirror tub, to get the instrument to balance properly, JMI adds a fairly massive, metal counterweight directly behind the mirror. While this sometimes causes the counterweight to radiate absorbed heat (which distorts image quality) into the optical path of the telescope, I saw no negative impact on images through the NGT-6. Indeed, these were some of the finest views I have ever seen through a 6-inch Newtonian.

I tested the NGT-6 during the winter, purposely taking the telescope out from a warm house into subfreezing temperatures to see how well it acclimates to the cold. Cool-down time averaged 40 minutes, typical for this size instrument. The winter also afforded me a good opportunity to test the NGT-6 while observing seasonal planetary and deep-sky treasures.

Alignment ranges allow for polar alignment from latitudes between 25 degrees and 45 degrees as well as the second range that spans 43 degrees to 58 degrees (either north or south latitude, since the drive is reversible). Use the hinged sight tube on the side of the mount to align to the celestial pole. The telescope's clock drive keeps the field centered on a target for about 30 minutes without recentering.

On to the star test -- that tell-all inspection where a star image is brought slightly outside of focus, then compared to the same image slightly inside of focus. Sure enough, these star images were perfect, confirming the high quality of the NGT's made-in-the-Ukraine mirrors.

In order to gain access to the eyepiece when aimed at different points in the sky, the entire optical tube assembly rotates within the split-ring mount. Unfortunately, the tub ring on the NGT-6 model I tested was slightly bent, making rotation by hand uneven and difficult.

The Sky and the Limit

Moving to some favorite sky objects, I began with M42, the Orion Nebula. Using a 22mm Tele Vue Panoptic eyepiece (34x), the view was wonderful, with many subtle turns and twists of M42 interwoven among the stars that littered the field.

Switching to my 7mm Pentax XL eyepiece (109x), I concentrated on the stars in the Trapezium. The four brightest were easily resolved even at low power, but I was going for bigger game: the fainter fifth and sixth stars nestled within. Normally, these objects are reserved for 8-inch or larger reflectors or the fine optics of a refractor, but I could make out the fifth star using this NGT (the sixth remained elusive).

The view of M42 and the clarity offered by the dark, midwinter sky impelled me to push the little NGT to the limit. Swapping eyepieces for my 12mm Nagler (64x), and attaching a hydrogen-beta nebula filter, I swung the telescope toward the star Alnitak, the easternmost star in Orion's belt. Shifting just one degree to the south, I began searching for IC 434 behind the elusive Horsehead Nebula.

While easy to capture on photographs, both objects are notoriously difficult to spot visually. Sure enough, I could definitely make out the sharp edge of IC 434 slicing through the eyepiece's field, although the subtle protrusion of the Horsehead evaded detection. Nonetheless, I consider seeing IC 434 through a 6-inch instrument quite a triumph.

All the Details

To test the accuracy of the factory-installed NGC-microMAX digital setting circles, I followed their guidance toward the compact globular cluster M79 in Lepus, to the south of Orion. There it was, just slightly off-center in the field of my 22mm Panoptic. Switching to a 12mm Nagler eyepiece, I could partially resolve its myriad stars, another impressive feat for a 6-inch, since the brightest stars in M79 are close to 14th magnitude.

After spending some time admiring several southern open clusters in Puppis, I set the NGC-microMAX to M31, the Andromeda Galaxy, which was setting in the northwest at the time. By following the aiming advice displayed on the circle's digital readout, the target was within the field of the 25mm Plossl eyepiece that came with the NGT. M31's two companion galaxies, M32 and M110, were also in this same field of view, offering a pleasant panorama of the nearest major galaxy system to our Milky Way. Increasing magnification with the 12mm Nagler, I could also make out the major dust rift that encircles M31's outer girth.

A 6-inch f/5 reflector is usually thought of as a great wide-field telescope, but not necessarily compatible with planet-viewing. However, with Jupiter and Saturn both nestled among the stars of Taurus at the time, how could I resist? I plugged in my 7mm Pentax XL eyepiece once more and pointed the scope toward Jupiter.

I was pleasantly surprised. Jupiter showed an amazing amount of detail in its clouds, with subtle festoons and other irregularities clearly visible. Saturn was no less impressive; Cassini's Division was easily discernable around the rings. The Saturnian equatorial region was also evident. The sharpness of both planets pointed to the high quality of those Ukrainian mirrors.

The NGT's split-ring mount tracked the sky just fine throughout my tests, but I found it a little "bouncy" -- most likely a result of the scant weight of the instrument. I often had to wait several seconds for the image to settle down when adjusting the focus, especially with higher magnifications. Tightening the axes helped a bit, but some unsteadiness remained.

I also found that the RCF-mini 1 focuser was a little stiff for my liking when turned by hand, especially with the 7mm Pentax. Its design makes tension adjustment impossible, although applying a slight amount of a dry silicon lubricant helped. The optional Motofocus eliminated the problem, but focuser travel was also somewhat limited. While this shouldn't prove to be much of a drawback with most eyepieces, those with a greater focus range may not work correctly. I ameliorated the problem by repositioning the truss rods into the second set of brass fittings on the nose assembly.

Overall, I give the NGT-6 very high marks in terms of optical quality and mechanical ingenuity. The mount moves very smoothly and tracks the sky effortlessly, while the optics are among the finest I have ever seen in a 6-inch telescope. If you are looking for a compact instrument capable of showing deep-sky objects as well as the planets, and want something a little more sophisticated than a Dobsonian, put the NGT-6 at the top of your list.

Product Details

JIM'S MOBILE, INC.
810 Quail Street., Unit Es
Lakewood, CO 80215
(303) 233-5353 • Fax (303) 233-5359
Orders (800) 247-0304
E-mail: info@jimsmobile.com
Web site: http://www.jims
mobile.com
Type: Newtonian reflector
Mount: Equatorial split-ring
Mirrors: 6-inch f/5 primary,
1.3" diagonal secondary
Weight: Approximately 26 lb.
Assembled Size:
Height: 35" Width: 14.75" square
Eyepiece height when aimed
at zenith: 31" (without tripod)
Disassembled Size: Approximately 18" Height

STANDARD FEATURES:
Rotating Optical Tube Assembly
RCF-mini 1 Focuser
25mm 1.25" Plossl Eyepiece
Starpointer Finder Scope
Polar Finder Sight Tube
Open, Serrurier truss
tube assembly
Split-Ring Equatorial mount
with 9-volt DC clock drive

~~~~~~~~

By Phil Harrington
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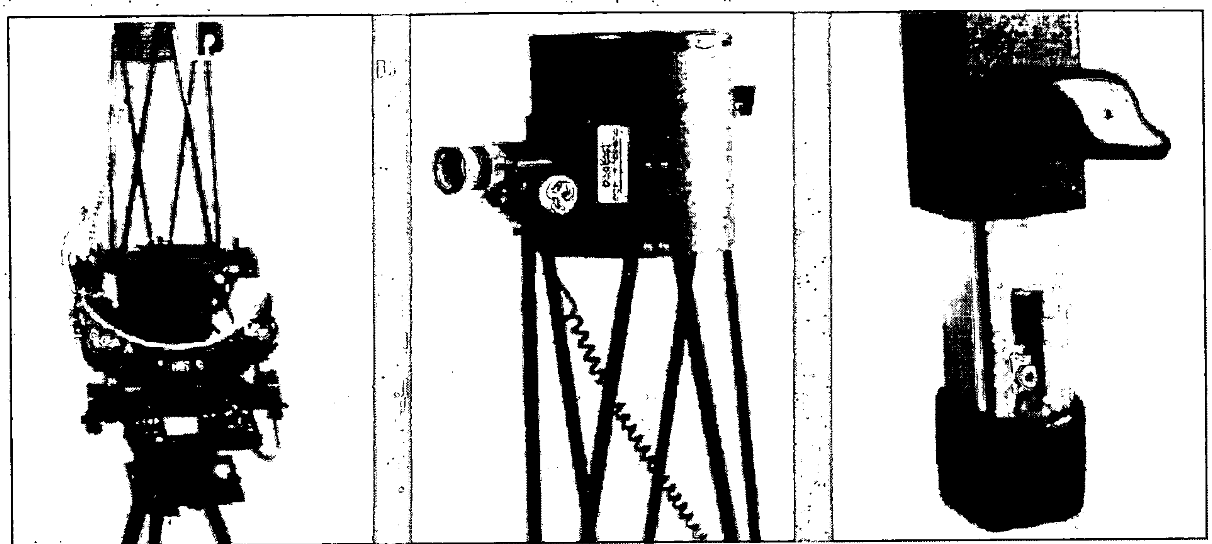
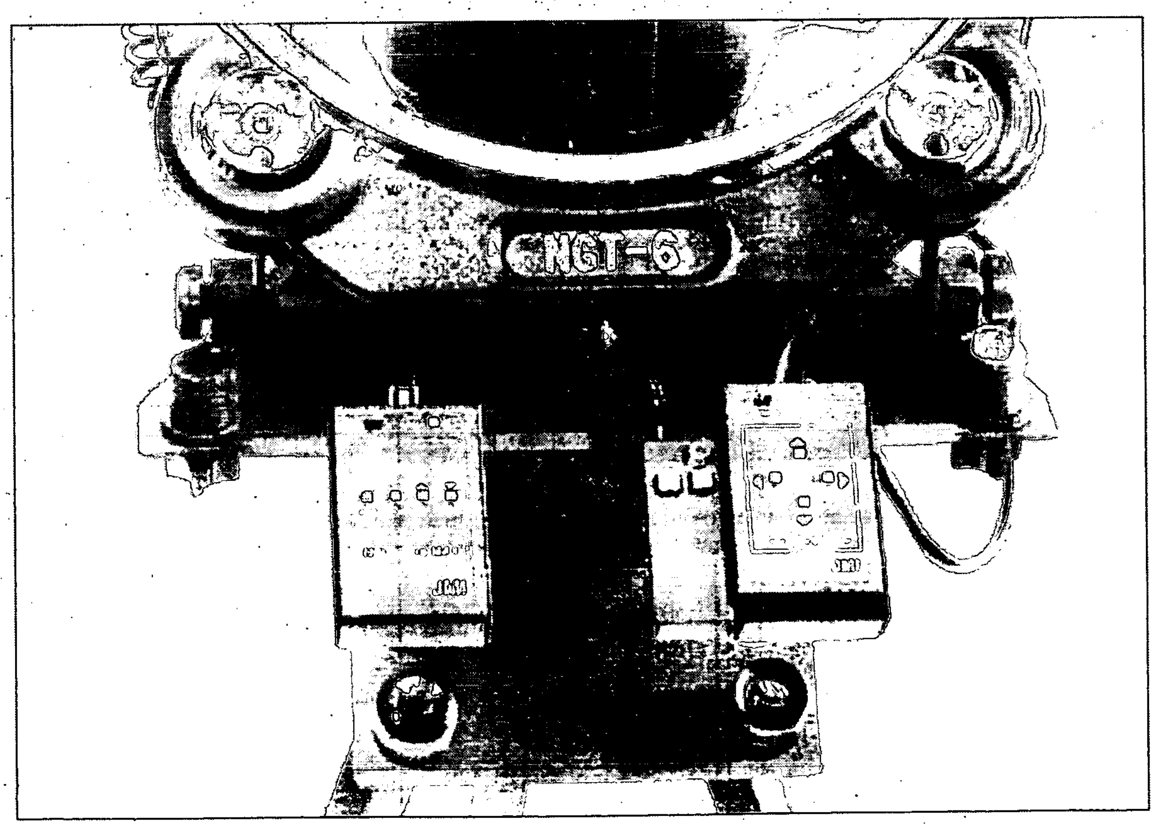
Phil Harrington's Star Ware, a consumer's guide to astronomical equipment, is available through bookstores as well as directly from his website at: http://www.philharrington.net.

Source: Astronomy, Oct2001, Vol. 29 Issue 10, p68, 4p
Item: 5090526



Left to right: The NGT-6's split-ring equatorial mount mimics the mount of its famous larger cousin, the Hale Telescope at Mount Palomar; sturdy composite rods support the tub assembly and eyepiece; a flashing LED tripod tip keeps observers alert.



Above: Convenient placement of the electronic controls facilitates alignment and observing.

Re: ATM Where to put the 3 teflon pads on rocker box base?

- *To*: Geoff Dudley <GEOFF@bedrock.ls.swin.edu.au>
- *Subject*: Re: ATM Where to put the 3 teflon pads on rocker box base?
- *From*: WESTLAND JAMES CHRISTOPHER <westland@uxmail.ust.hk>
- *Date*: Sat, 16 Dec 1995 16:52:58 +0800 (HKT)
- *Cc*: atm@shore.net
- *In-Reply-To*: <MAILQUEUE-101.951214122440.416@bedrock.ls.swin.edu.au>
- *Reply-To*: WESTLAND JAMES CHRISTOPHER <westland@uxmail.ust.hk>
- *Sender*: owner-atm@shore.net

```
I'm interested in the response to this question ... I am building an 18"
Dob, and I designed the Az track to have the same contact area (between 3
pads) as that provided by the 4 pads on the altitude bearings.  Putting
them outboard keeps the box from rocking around the center pivot. If the
base is square, then the largest track that will fit inside the square of
the base has diameter around 1 over the square root of 2, or .7071 of the
diagonal size (which is close enough to 2/3 = .67) ... I think this is where
these numbers arise (though I have never seen anyone mention them)

-c

**********************************************************************
Chris Westland
Hong Kong U. of Science & Technology
Tel:                  ++852 2358 7643
Fax:                 ++852 2358 2421
Internet:           westland@uxmail.ust.hk
URL:              http://www.bi.ust.hk/sbm/dbm/hkust.html
*************************************************************************


On 14 Dec 1995, Geoff Dudley wrote:

> Is there a special position I need to put the 3 teflon support pads?
>
> I'll be using Ebony Star as the rubbing surface. Do the pads have to
> be 2/3 's the way out or right on the edge or .7071 the circumference
> or what? I have Tom Clark's book "The Modern Dobsonian" and he
> doesn't mention it.
>
> I have a 12" f/6 full thickness mirror in the mirror box.
> Best regards,
>
> Geoff Dudley
> gwd@swin.edu.au
>
>
```

- **References**:
  - **ATM Where to put the 3 teflon pads on rocker box base?**
    - *From:* "Geoff Dudley" <GEOFF@bedrock.ls.swin.edu.au>

- Prev by Author: **Re: ATM poncet**
- Next by Author: **ATM FYI -- AstroSystems Components**
- Prev by thread: **Re: ATM Where to put the 3 teflon pads on rocker box base?**
- Next by thread: **Re: ATM Where to put the 3 teflon pads on rocker box base?**
- Index(es):
  - **Author**
  - **Thread**

62/9/1 (Item 1 from file: 2)
DIALOG(R)File 2:INSPEC

01382115 INSPEC Abstract Number: A79070953
Title: The 'Hill-**Poncet**' heated observatory: a 'rocking-type' **equatorial**
Author(s): Ells, J.W.
Author Affiliation: Crayford Manor House Astron. Society, The Manor House, Crayford, UK
Journal: Journal of the British Astronomical Association vol.89, no.1 p.66-78
Publication Date: Dec. 1978 Country of Publication: UK
CODEN: JBAAA6 ISSN: 0007-0297
Language: English Document Type: Journal Paper (JP)
Treatment: Practical (P)
Abstract: This paper describes the modification of a heated altazimuth observatory, of the type originally designed and built by Hill (1962) housing a 32 cm Newtonian reflector. An **equatorial** sub-mounting, developed from the design of the French amateur astronomer **Poncet** (1977) was built and the Hill observatory mounted on it. The result is a very stable observatory with true **equatorial** motion in which the observer is able to work in warmth and considerable comfort. (4 Refs)
Subfile: A
Descriptors: astronomical instruments; astronomical observatories; astronomical **telescopes**
Identifiers: heated altazimuth observatory; true **equatorial** motion; Hill **Poncet** heated astronomical observatory; Newtonian reflecting **telescope**; rocking type **equatorial** submounting
Class Codes: A9545 (Observatories); A9555C (Ground-based telescopes); A9555S (Auxiliary and recording instruments)

1/9/5
DIALOG(R)File 350:Derwent WPIX

008842340 **Image available**
WPI Acc No: 1991-346356/**199147**
XRPX Acc No: N91-265211

Pivotless equatorial table e.g. for telescope - has conical assembly which allows table portion to coact with rolling bodies about common virtual axis

Patent Assignee: JUPITER TELESCOPE (JUPI-N)
Inventor: DAUTUME G
Number of Countries: 001 Number of Patents: 001
Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
US 5062699	A	19911105	US 89392449	A	19890811	199147	B

Priority Applications (No Type Date): US 89392449 A 19890811

Abstract (Basic): US 5062699 A

The equatorial table comprises a planar telescope table portion having a top side and bottom side. A table base is situated below the table portion, the table base having provided upon several rolling bodies.

A conical assembly allows the table portion to coact with the rolling bodies about a common virtual axis. The common virtual axis is aligned in parallel with the polar axis of the earth. The conical assembly comprises several tracks constrained by gravity to remain in contact with the rolling bodies. The tracks are rotation symmetrical about the common virtual axis.

USE/ADVANTAGE - Optical and radio telescope, satellite tracking device. Allows axis of rotation to pass through centre of gravity of movable section, thereby improving balance and reducing energy required to power table while keeping size of table at near minimum. (7pp Dwg.No.1/6)

Title Terms: PIVOT; EQUATOR; TABLE; TELESCOPE; CONICAL; ASSEMBLE; ALLOW; TABLE; PORTION; COACT; ROLL; BODY; COMMON; VIRTUAL; AXIS
Derwent Class: P81; S01; S02; W02
International Patent Class (Additional): G02B-023/16
File Segment: EPI; EngPI
Manual Codes (EPI/S-X): S01-J09; S02-B09; W02-B06

1/9/6
DIALOG(R)File 350:Derwent WPIX

008228228 **Image available**
WPI Acc No: 1990-115229/**199015**
XRPX Acc No: N90-089279
Equatorial mounting system and drive - comprises safety trunnion receiving pairs of declination studs on telescope or camera
Patent Assignee: HARBOUR D A (HARB-I)
Inventor: HARBOUR D A
Number of Countries: 001 Number of Patents: 001
Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
US 4904071	A	19900227	US 88259972	A	19881018	199015	B

Priority Applications (No Type Date): US 88259972 A 19881018

Abstract (Basic): US 4904071 A
The equatorial mount comprises a safety trunnion which receives any of a number of pairs of declination studs on the telescope or camera. It has a safety access channel that has a first vertical segment and a second angulated segment forming a crook between. In the event the trunnion assumes an inverted position, the declination studs will slide into the crook between the two segments and be retained in the equatorial mount by the angulated segment.

The pairs of studs permit the instrument to be rotated about its longitudinal axis and reinserted should the eyepiece or viewing lens be positioned at an inconvenient angle. A guided sector drive provides an inexpensive device for driving the equatorial mount in right ascension to track a celestial body.

USE/ADVANTAGE - For optical instruments that affords quick setup e.g. in telescopes, cameras. (7pp Dwg.No.2/7)
Title Terms: EQUATOR; MOUNT; SYSTEM; DRIVE; COMPRISE; SAFETY; TRUNNION; RECEIVE; PAIR; DECLINE; STUD; TELESCOPE; CAMERA
Derwent Class: P81
International Patent Class (Additional): G02B-023/16
File Segment: EngPI

35/9/9 (Item 1 from file: 141)
DIALOG(R)File 141:Readers Guide

01300171 H.W. WILSON RECORD NUMBER: BRGA88050171
Equatorial tables without a pivot.
D'Autume, Georges.
Sky and Telescope v. 76 (Sept. 1988) p. 303-7
DOCUMENT TYPE: Feature Article
SPECIAL FEATURES: il ISSN: 0037-6604
LANGUAGE: English
COUNTRY OF PUBLICATION: United States
RECORD TYPE: Abstract RECORD STATUS: Corrected or revised record

ABSTRACT: A description of a **Dobsonian** telescope that rides on an **equatorial table**. The telescope performs well in both low and high **latitudes**. It has neither a solid polar axis nor a pivot, but it rotates around a virtual polar axis parallel to Earth's.

DESCRIPTORS:
Telescopes--**Mounting**

9/9/14 (Item 5 from file: 141)
DIALOG(R)File 141:Readers Guide

Attached

01771827 H.W. WILSON RECORD NUMBER: BRGA90021827
Astronomy tests a **Dobsonian equatorial platform.**
AUGMENTED TITLE: custom made by Tom Osypowski
Kanipe, Jeff.
Astronomy v. 18 (Apr. 1990) p. 52-5
DOCUMENT TYPE: Product Evaluation
SPECIAL FEATURES: il ISSN: 0091-6358
LANGUAGE: English
COUNTRY OF PUBLICATION: United States
RECORD TYPE: Abstract RECORD STATUS: Corrected or revised record

ABSTRACT: Tom Osypowski's motorized **equatorial platforms** for **Dobsonian** telescopes are remarkable for their smooth **tracking**, stable and portable design, sturdy drive system, and quick and easy set up. The single- and dual-axis **platforms**, which range in price from $875 to $1,750, are custom-built to the buyer's telescope size and **latitude** and provide up to an hour of **tracking** time. The many advantages afforded by the **platforms** make them worth the price.

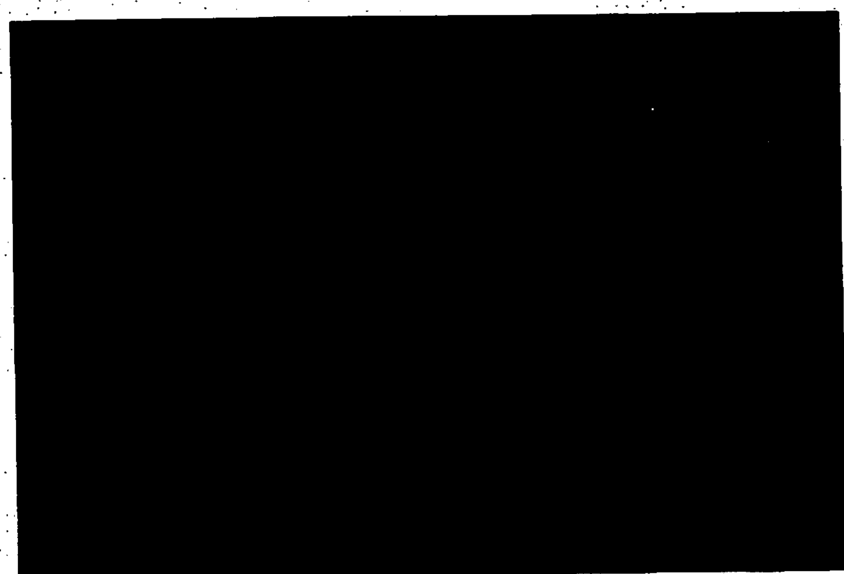
DESCRIPTORS:
Dobsonian telescopes--**Mounting**; Telescopes--**Mounting**
Product evaluation

Astronomy Tests a Dobsonian Equatorial Platform
Kanipe, Jeff
Astronomy; Apr 1990; 18, 4; Research Library
pg. 52

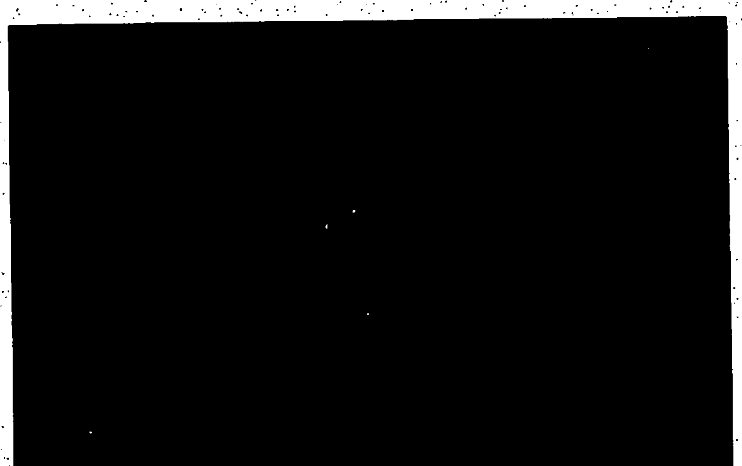
ASTRONOMY Tests a Dobsonian Equatorial Platform

This custom-made, motorized ground board gives your big Dob an hour of smooth tracking.

by Jeff Kanipe



THE SATURN OCCULTATION of 28 Sagittarii was recorded by Tom Osypowski with a 16-inch Dobsonian on his equatorial platform.



PIGGYBACK ASTROPHOTOGRAPHY with the platform yielded this unguided 2-minute exposure of the Double-Cluster region on Ektachrome 400 film.

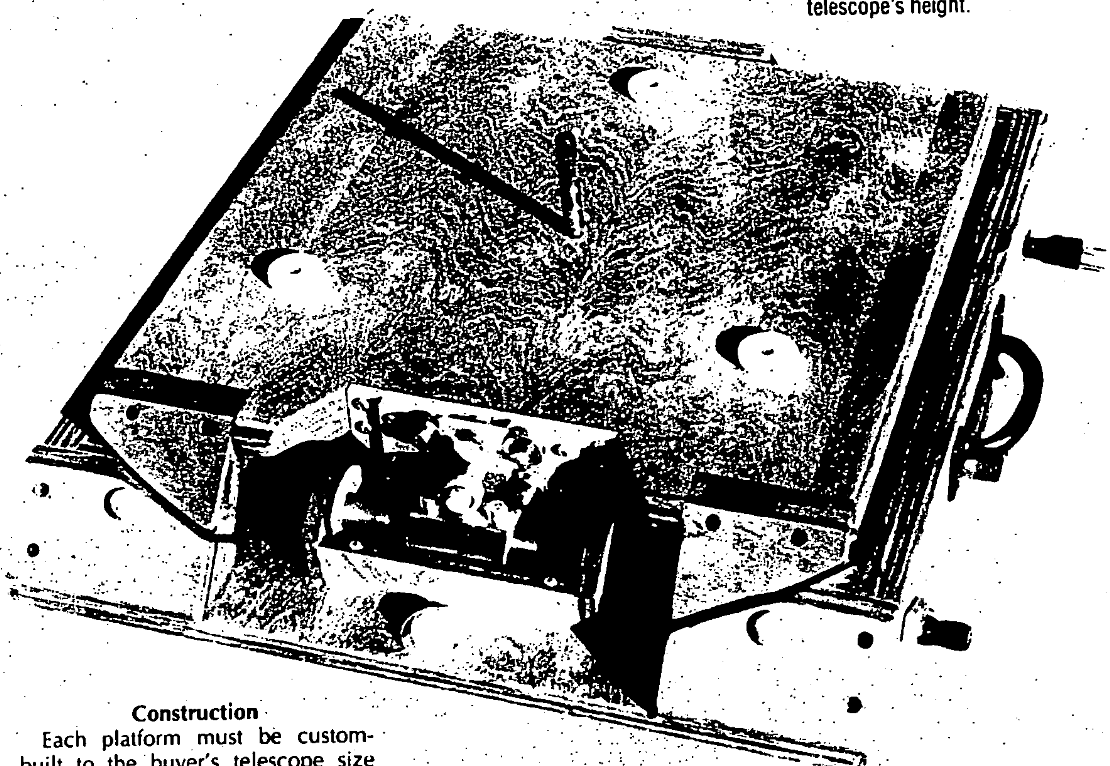
One of the greatest strengths of a Dobsonian telescope — its solid altazimuth mount — is also its greatest weakness. Since no axis in an altazimuth system aligns with the celestial pole, the mount cannot be easily motor driven. You have to continuously nudge the tube to track the object in the field of view.

Almost as soon as the Dobsonian became popular in the mid-1970s, attempts were made to design a mount that could track. A real advance in this direction was made in 1977 with the introduction of a motorized ground board called a Poncet platform, named for its designer, French amateur astronomer Adrien Poncet.

Then in 1984, in an article written for *Telescope Making* magazine (*TM #24*), telescope makers and amateur astronomers read about Tom Osypowski's equatorial platform, itself a synthesis of two previous designs featured in *Telescope Making*. Like a Poncet, Osypowski's platform pivots around a bolt located on the southern end that is inclined at an angle equal to the observer's latitude. His design, however, does not rely on an inclined plane but rather two curved surfaces, or "feet," that ride on two roller bearings on the lower platform. This approach produces a lower center of gravity and, therefore, greater stability than the Poncet provides.

Four years after the article appeared in *Telescope Making*, Osypowski was selling custom-made versions of his platform. We wanted to see how stable the platform is and assess how well it tracks for both visual and photographic use. Last August we asked Osypowski to loan us a single-axis platform for a 13.1-inch f/4.5 Dobsonian. He had it built and delivered to our office by the end of November.

A LOW CENTER OF GRAVITY translates into a stable platform that adds only a few inches to the telescope's height.



Construction

Each platform must be custom-built to the buyer's telescope size and latitude. Our platform has a base 21 3/4" x 23" and weighs about 25 pounds. The wooden components are constructed from birch plywood, which is sanded and stained with two coats of sealer. To assure that all joints stay together, glue and screw construction is used throughout.

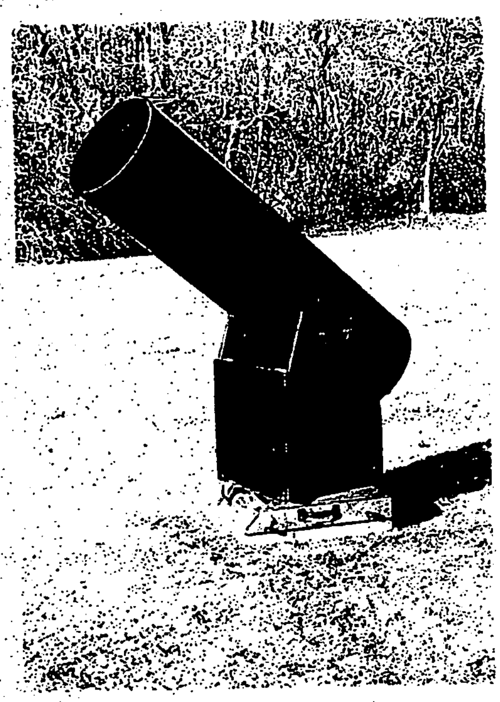
One limitation that immediately comes to mind is the latitude-specific construction: What if you leave your observing location for a different latitude? Is the platform still usable? The platform can be used in other latitudes by simply shimming the north or south side the appropriate number of degrees. A platform built for 43° latitude can be used for 40° latitude by shimming the south end 3°. At 46° latitude the north end would be shimmed 3°.

The greater the latitude difference, of course, the more the platform must be tilted, and this eventually imposes a limit. For example, our latitude is 43°. If we took our platform to the Texas Star Party in Fort Davis, Texas, (about latitude 31°), we'd have to raise the south side 12°, or about 5 inches — not the most stable situation for any size Dobsonian. This is a factor to consider before making a purchase. The traveling observer might contact Osypowski for an opinion on what the platform's limit of stability is for a specific telescope.

Another important limitation is that the single-axis model is designed primarily for visual use, piggyback astrophotography, and lunar and planetary photography. This type of platform does not have a declination adjustment. Observers interested in guided, long-exposure photographs through the telescope should consider Osypowski's dual-axis model, which is capable of fine adjustments in declination.

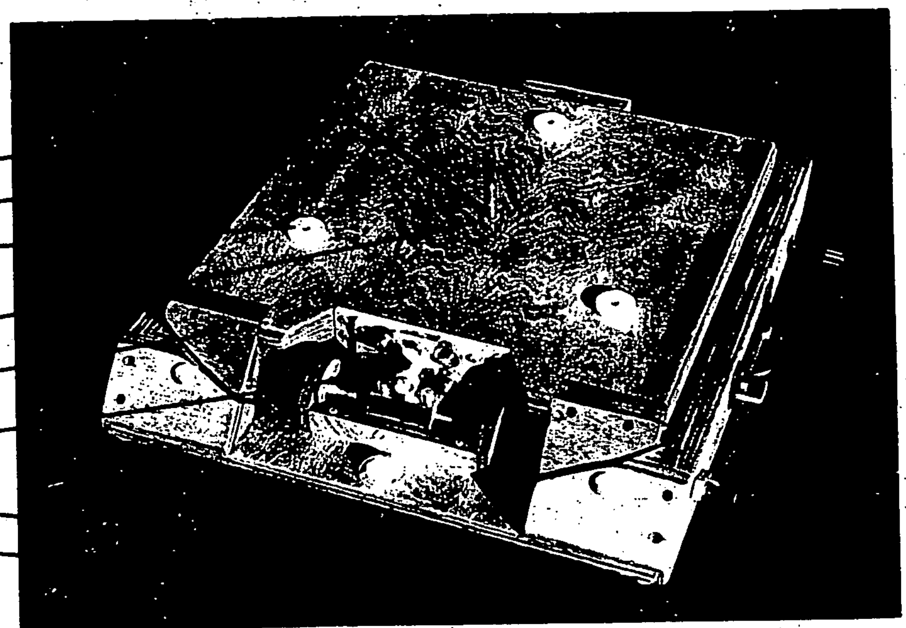
The platform has two sections, an upper rocking plate and a bottom support plate. The rocking plate replaces the scope's ground board in that the telescope's rocker box is secured to the rocking plate with a bolt (like that of the ground board) and the rocker swivels over three Teflon pads. Two curved "feet" are attached to the underside of the top plate on the north end and are inclined to the latitude angle.

The curved feet, attached to the underside of the rocking plate, allow the platform to arc through an hour's worth of right ascension by sliding

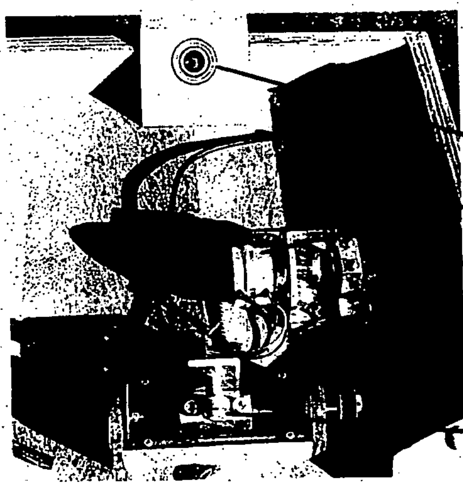


THE EQUATORIAL PLATFORM replaces the scope's ground board. (Patio bricks provide a level surface for the platform.)

The Assembled Platform



The Inner Components



DRIFTING STAR IMAGES, recorded with the platform's polar axis purposely misaligned, show a tolerable periodic error in the drive rod of about 24 arcseconds.

over two roller bearings located in the corners of the north side of the bottom support plate. The rocking plate pivots around the polar-axis bearing, which is positioned in the middle of the south side of the support plate.

Operating the Platform

All mechanical and electronic components are located on the support plate, under the rocking plate. When the platform is operating a synchronous motor actuates a belt that turns a drive rod through a brass drive nut. A ball joint mounted on top of the drive nut and threaded into the rocking plate via a "slider assembly" helps the rocking plate swivel smoothly as it is being driven.

Set up is simple. First, set the platform on a hard surface with the bubble level facing north. If necessary shim the corners until the platform is level and stable. Rough polar alignment is achieved by lining up either the east or west side of the platform with Polaris. For somewhat more accurate alignment, mount the telescope on the platform, square off the telescope's rocker box with the sides of the rocking plate, and sight on Polaris (or the region of celestial north) along the sides of the box. For astrophotography, the star-drift method must be used.

Once the telescope is mounted and the platform is aligned with Polaris, lift the motor lock on the west side of the platform and swivel the motor plate forward to disengage the drive belt from the pulleys. The rocking plate can then be positioned for an hour's tracking by turning the hand crank clockwise until the drive nut is all the way over to the right. (This tilts the rocking plate toward the east.) The motor is then relocked and the drive belt checked to make sure that it is seated on the pulleys.

There is no on-off switch. The platform simply begins tracking once plugged into a 110-volt source. The motor, sandwiched between the upper and lower plates, makes a subtle grinding sound. You can tell the platform is working normally by checking to see if the hand crank is

turning freely. As the hour progresses the drive nut makes its way along the drive rod from right to left. At the end of its tracking run it trips a switch that automatically shuts off the motor. You then disengage the motor lock, shift the motor plate forward, rewind the drive nut, shift the motor plate back, and begin tracking for another hour.

Performance

We evaluated the platform's performance in terms of visual use, photographic use, and stability. The visual tests were made using three eyepieces: a 32mm Erfle (45x and a 1.4° true field), a TeleVue 21mm Plossl (68x and a 0.7° true field), and a 10mm Ultrascopic™ (144x and a 0.4° true field). Depending on the focal length of the eyepiece and how "rough" you polar align, tracking can be quite good. For visual purposes, we sighted Polaris along the edge of the platform as the manual suggests and averaged the results over a period of four nights.

A bright star remained centered in the 32mm Erfle eyepiece for about three and a half minutes before drift became noticeable. In the 10mm, drift was detected in about thirty seconds, but it took nearly four minutes before the star edged against the field stop. These results yield an average drift of about 2.5 to 3 arcminutes per minute.

For visual use, the platform works well. But for astrophotography success depends on accurate polar alignment. With rough polar alignment, tracking was good enough for recording the Moon at prime focus with 400-speed film. It was also suitable for a piggyback setup using fast film and a 50mm lens. Longer-focus lenses, however, required more precise polar alignment.

I polar aligned via the star-drift method and made several 3- and 4-minute *unguided* exposures of the Double Cluster, the Pleiades, and the Orion Nebula using Ektachrome 400 film. Although some of the exposures were trailed slightly, a single-axis drive corrector and careful guiding through the telescope using a high-power eyepiece would no doubt produce even better results.

The tracking exhibited no discernible jerkiness and an acceptably small periodic drive error. The user's guide suggests that the backlash adjustment set screws, located at each end of the drive nut, should be tightened just enough to minimize backlash of the drive nut without slowing down the rod. I never had to make these adjustments.

Our only complaints with the platform are minor ones that could easily be fixed by the manufacturer. First, the platform's handle is difficult to grasp because of its location near the motor plate and lock. The motor plate protrudes in such a way that your fingers can't wrap securely around the handle without pinching. We also had trouble with the crank not turning freely on the side of the platform. After resetting the mechanism one time, the threaded handle screwed down so tightly against the side of the platform that the motor locked up. This was fixed by simply placing a washer between the crank and the housing. Finally, after plugging and unplugging the platform in the dark a few dozen times, I think an on-off switch would be a convenience.

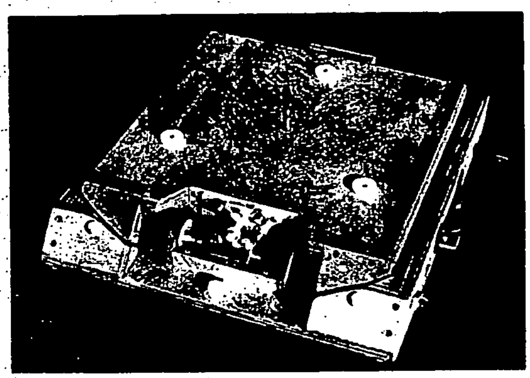
Observers who have longed for a painless method of driving their Dobsonians equatorially will welcome Osypowski's platforms. However, be prepared to pay serious bucks for his design. (See above.) Platforms are available for telescopes as large as 26". Osypowski will also provide telescope makers with the mechanical parts and drive assemblies needed to build their own platforms at a reduced price.

The equatorial platform we tested provided an hour's worth of smooth tracking without sacrificing Dobsonian portability or stability. The platforms are well made, easy to use, and, with a little shimming, can be used at other latitudes. Although the cost may seem high, the opportunities and advantages afforded by a motorized equatorial platform are worth the price. □

Tom Osypowski's Equatorial Platform

A motorized equatorial platform for Dobsonian telescopes, custom-made for the observer's telescope size and latitude. The platform, which provides up to an hour of tracking time, consists of two sections: the top rocking plate, which supports the telescope and has two curved "feet" inclined at the observer's latitude angle on the north end; and the support plate, containing the drive system, north roller bearings, and south pivot bearing. Two types of platforms are available. Single-axis platforms are suitable for visual use, lunar and planetary photography, and piggyback astrophotography. Dual-axis platforms, when used with a dual-axis drive corrector, allow for declination adjustments and are recommended for prime-focus deep-sky photography.

Manufacturer: Tom Osypowski, 11065 Peaceful Valley Road, Nevada City, California 95959; (916) 265-3183 (evenings).



List Price: For 12" to 14" Dobsonians, $875 single axis, $1,125 dual axis. For 16" to 18" Dobsonians, $1,175 single axis, $1,750 dual axis. Larger sizes available. Mechanical parts and drive assemblies can also be supplied. Price list available.

Pros: Smooth tracking; stable, portable design; stout drive system; quick and easy set up.

Cons: No on-off switch; carrying handle too close to motor swivel-plate lock; limited latitude range; high price.

Summary: A sturdy customized motorized equatorial platform for owners of large Dobsonian telescopes. A heavy-duty threaded drive system provides an hour of smooth tracking for visual use or for those who want to photograph the planets, Moon, Sun, or engage in piggyback astrophotography. The platform's low center of gravity adds about three inches of height to the telescope, allowing for quick set up and portability.

50/9/2 (Item 2 from file: 2)
DIALOG(R)File 2:INSPEC

00453756 INSPEC Abstract Number: A72078633, B72040614
Title: System design of a large steerable radio **telescope**
Journal: JAEU (Journal of Asia Electronics Union) vol.5, no.2 p. 38-44
Publication Date: 1972 Country of Publication: Japan
CODEN: JAEUAB
Language: English Document Type: Journal Paper (JP)
Treatment: Practical (P)
Abstract: The system design of the Ootacamund radio **telescope** is described. The **telescope** consists of a large parabolic cylinder 530m long in north-south direction and 30m wide in east-west direction and operates at a frequency of 327 MHz. An array of 968 half-wave dipoles placed along the focal line of the **telescope** illuminates the reflecting surface. The long axis of the cylinder has been made parallel to the axis of rotation of the **earth** by locating the cylinder in the north-south direction along a hill whose slope is equal to the local **latitude**. Thus a radio source in the sky can be **tracked** in hour angle for 9.5 hours per day by continuous **mechanical** rotation of the reflector. Steerability in declination is achieved electrically by means of trombone type of phase shifters placed between successive dipoles. (10 Refs)
Subfile: A B
Descriptors: astronomical **telescopes**; dipole antennas; radioastronomy; radiotelescopes
Identifiers: 968 half wave dipoles; 530 metres long in north south direction; 30 metres wide; system design; Ootacamund radio **telescope**; 327 MHZ; steerability; phase shifters
Class Codes: A9555 (Astronomical and space-research instrumentation); B5270B (Single antennas); B6360 (Radioastronomical techniques and equipment)

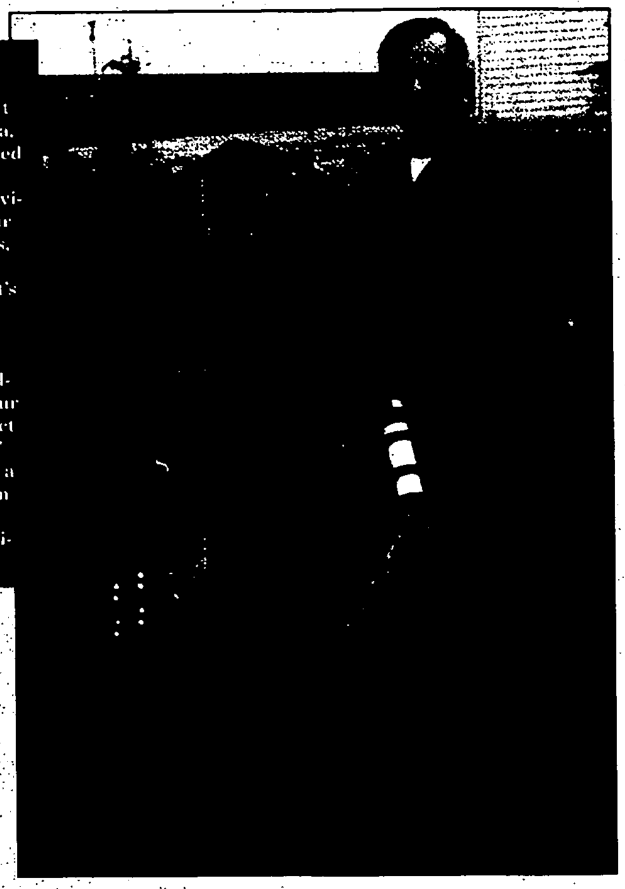
"Think Dob" but Build Equatorial

WOODWORKING techniques were my only option for the 8-inch reflector I was planning. Naturally, my first thoughts were to build a Dobsonian mount with its well-known stability and smooth motions. However, because such a mount allows movement only in altitude or azimuth, it is rather awkward for sweeping the sky directly overhead. I decided to explore some alternatives.

My challenge was to devise a mount combining the following features:

- The mount should be an equatorial type, for access to zenith and ease of tracking the stars.
- No machining should be required, with plywood as the primary construction material.
- The bearing surfaces should be of Ultra High Molecular Weight (UHMW) plastic, a low-friction material available at woodworking stores or through mail-order houses. (Teflon is even better but harder to find.)
- All gravity loads must be transferred as directly as possible to the ground, with no significant forces acting to bend the structural members.

An easy-to-build, low-cost mount appealed to me for other reasons, too. I could make an identical pair and leave one at a remote observing site without worrying about it. I'd need to transport only the tube assembly. Furthermore, to make a Dobsonian follow the stars requires computerized altazimuth motors or an equatorial table, but the approach described here can track with a simple sector-type drive.



Despite the all-wood construction of his 8-inch f/6 reflector, Scott Jamieson of Waukesha, Wisconsin, has achieved smooth motions and excellent damping of vibration. Note that four ground-contact points, instead of three, increase the instrument's stability. "In my next telescope," Jamieson comments, "I'll make the side stabilizers adjustable so that all four can make good contact with uneven terrain." He is an engineer for a major electronics firm and a member of the Milwaukee Astronomical Society.

THE MOUNT

All parts of my mount were cut from ¾-inch plywood and 2-by-6 lumber. The tube is made of ¼-inch plywood, except for a ¼-inch doubler where it attaches to the mount.

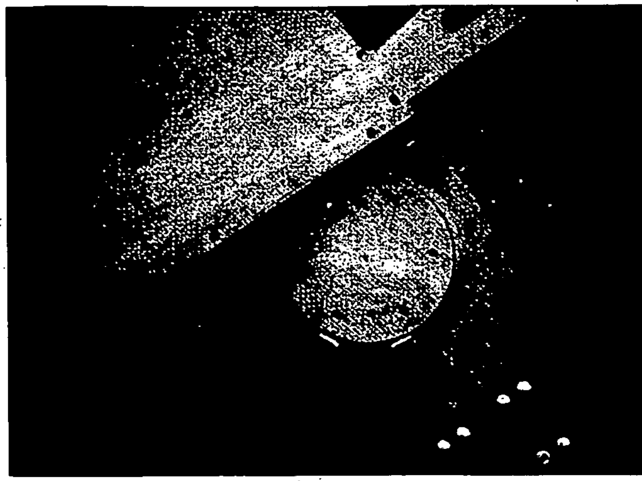
The polar axis is straightforward, utilizing an 8-inch wood disk that is tilted to face the north celestial pole. The rim is wrapped with a strip of ordinary Formica that glides smoothly on two UHMW pads attached to the base of the mount. At the southern extension of the polar axis is a ½-inch bolt on which a washer-shaped UHMW pad is placed to act as a thrust bearing. The bolt is inserted into a slot in the base.

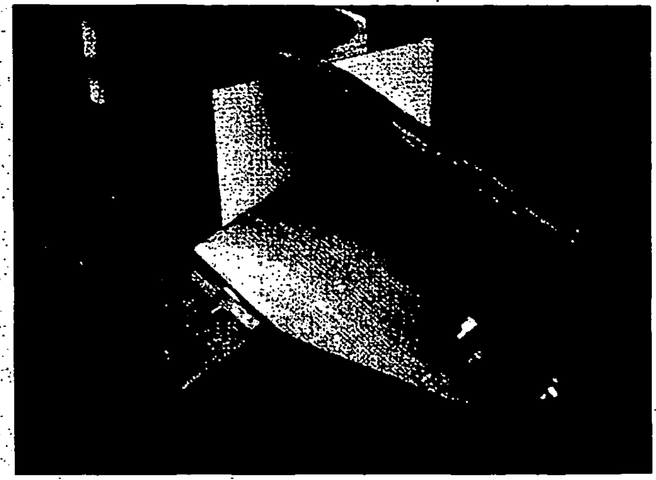
The heart of my design is the improved method of supporting the telescope's weight at the declination axis. The equatorial head has three bearing pads and a ½-inch bolt at the center. The telescope is attached to this bolt with a washer-shaped UHMW pad, a steel washer, and a nut, all inside the main tube.

The three outlying declination pads support the tube only when it is on top of the mount, as when I'm viewing objects low in the eastern or western sky. During more normal viewing, when the telescope is hanging off to one side to scan the meridian, the tube is supported by the lower two bearing pads and the washer-shaped pad on the central bolt. In fact, under these conditions the upper pad is not in contact with the tube; the clearance is about 0.02 inch when the central nut is properly tightened down.

From an engineering standpoint the bearing pads act in compression alone, but the bolt is in tension and shear. This means loads are transferred directly to the equatorial head through the pads, which are about 5 inches away from the bolt. Two of the pads are always well placed for this purpose, no matter what part of the sky is being observed. The vertical loads from the equatorial head are transferred to the ground by the stout base structure.

The weakest aspect of a conventional German equatorial is that the loads are transferred through too many components. The tube is supported by a cradle that is coupled to the declination shaft. This shaft is carried successively by two bearings, the declination housing, then the polar shaft, its two bearings, and finally the polar-axis housing *before* the





Left: **This close-up of the mounting's north end shows four of the plastic bearing pads: two supporting the polar disk and two more under the telescope tube. These pads run against a strip of Formica on the polar disk and a sheet of the same material on the side of the tube. While the author designed his mount to work with a flat-sided tube, he points out that a round tube with a properly designed plywood cradle would also work.** ***Right:*** **Another view of the equatorial head, which is constructed of doubled ¾-inch plywood for extreme stiffness. Note the counterweights located on both sides of the central spine. Also note the washer-shaped bearing pad at the south end of the polar axis. The author supplied all photographs for this article.**

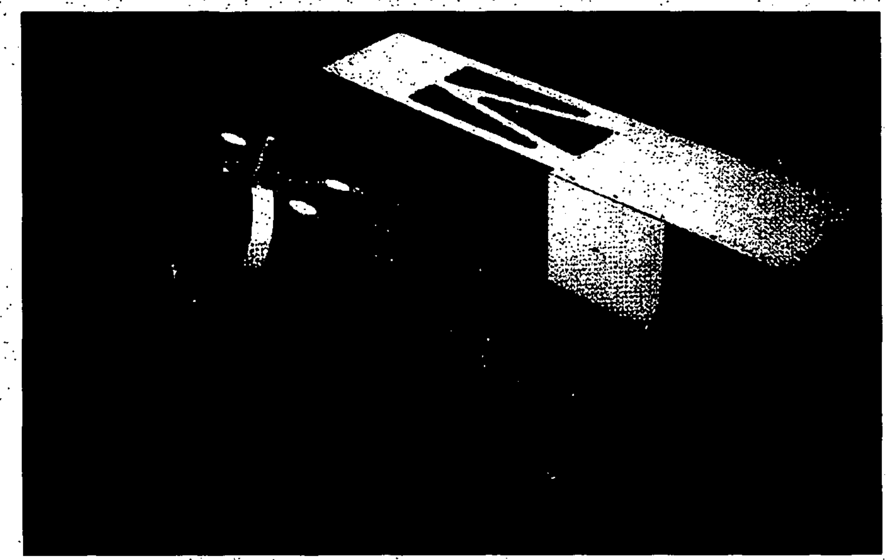
load passes through a pier or tripod to the ground. A metal mount of this type, even if well made, forms a giant tuning fork that can only be damped by massive construction.

My mount was built for latitude 30° because the telescope is a gift for a friend in Houston, Texas. Any other location would need a base cut for its latitude, the rest of the mount staying the same.

I don't pretend that my approach leads to the equivalent of a heavy, well-machined metal mount. However, the friction levels on both axes are reasonable and the tube stays where it is put, even in a good wind. A sharp rap on the tube damps out in about a second. The eyepiece is always in a convenient position on top or to the side.

I consider my mount to be a cross between the Dobsonian and German equatorial styles because it shares the best characteristics of both. Setting circles for aiming the telescope at any particular coordinates in the sky can be attached to the polar disk and underneath the tube, so their pointers would be visible from the north side.

The material from which I cut my bearings is sold by the name of UHMW Slick Strips, available from Trendlines, 375 Beacham St., Chelsea, MA 02150 (phone 800-767-9999). Each strip measures ¼ by 4 by 48 inches and costs $7.



With the tube removed, all three declination bearing pads and the central tension bolt are visible. One nut holds the tube to the axis assembly. The author has been very satisfied with bearings of this type and sees no reason they could not be scaled up for a much larger instrument. Notice how the primary-mirror cell, at extreme right, appears to have no adjustment screws for collimation. They are entirely concealed within the wood, as shown in the lower diagram on page 94.

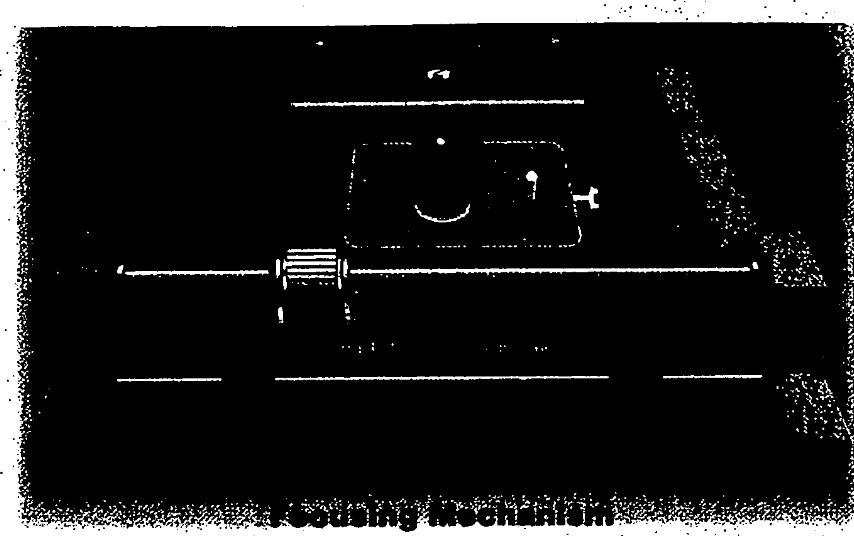
FOCUS MECHANISM

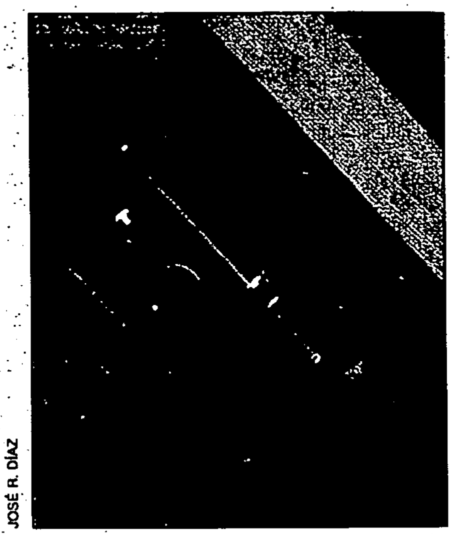
Eyepieces are inserted into a fixed tube attached to a plate that moves parallel to the main axis of the telescope (see the diagram and photograph at the top of the next page). This plate rides on a ¼-inch-diameter steel rod at one side and a 1½-inch-wide strip of aluminum on the other. The aluminum strip, 0.09 inch thick, slides between two nylon screws. To focus, I rotate a wheel that contains a captured nut and rides on a brass ¼-20 threaded rod. This mechanism provides very smooth motion throughout its 2-inch range and is capable of supporting a fairly heavy eyepiece or camera.

In a focuser of this type, the telescope's diagonal mirror must also be mounted on the moving plate. My diagonal is carried on a single stalk. For collimation, it is adjusted by loosening a nylon setscrew and either rotating the stalk or sliding it in or out.

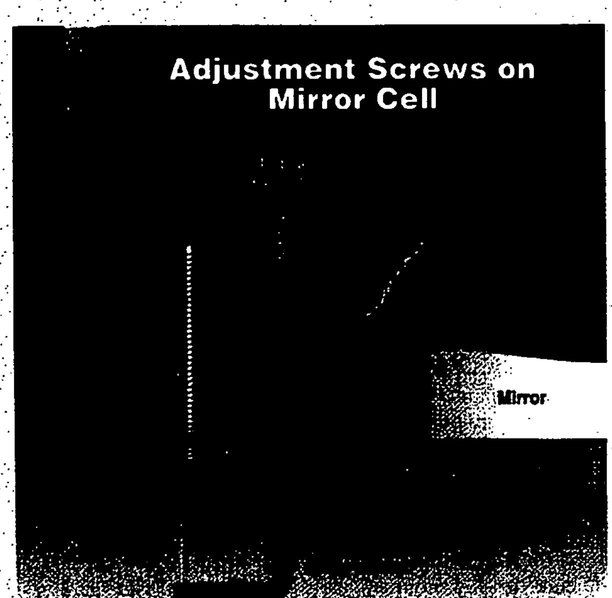
THE MIRROR CELL

The cell for my primary mirror is made of three thicknesses of ¼-inch plywood, two of which have an 8-inch-diameter hole to position the mirror radially. The rear picce has three 1/16-inch cork pads to support the mirror's back and a 4-inch hole to allow air circulation and help the mirror reach the same temperature as the night air. Three cork-faced clips re-





Like his equatorial mount, Jamieson's focuser has smooth motions normally associated with precision machining. Note that the eyepiece holder moves kinematically without superfluous restraints. If it were carried instead on two widely spaced parallel rails, it might bind if the wood frame were to distort with changes in humidity.



The holes for the wood screws have been widened to 5/16 inch for the initial 3/4 inch of their depth in order to contain a fairly stiff spring measuring 1 inch long when uncompressed. These screws spring-load the mirror cell against the heads of the adjacent Allen screws. After the optics have been collimated, the author snugs down the wood screws to make the adjustment firm.

strain the front of the mirror along the edge. There are no adjustments in this cell assembly.

Collimation is determined by the way the cell attaches. Inside the main tube are three small wooden blocks in which ¼-20 socket-head cap screws have been installed. The mirror cell rests against these screws, which are adjusted by inserting an Allen wrench through small holes aligned with the screw heads but smaller in diameter. Meanwhile, the cell is spring-loaded against the screw heads by three other screws, as illustrated above.

A big advantage of this cell is the ease with which it can be removed for storage separate from the telescope. When reinstalled, alignment is still very close. The type of cell is also very economical to make. I have tried it only on mirrors with a 1:6 thickness ratio; thinner ones will require additional support to prevent flexure.

I hope that this all-wood mount disproves the growing belief among many amateurs that the Dobsonian is the only alternative to an expensive, well-machined equatorial mount. I am currently building a 10-inch version, and this summer I hope to put together the tube assembly for a 12-inch reflector to use on the same mount. Additional refinements are surely possible, and I would enjoy hearing from others who try out this design for themselves.

SCOTT JAMIESON
513 Everett Dr.
Waukesha, WI 53188

The Juno 12.5 Equatorial Telescope
Sky and Telescope; Aug 1994; 88, 2; Research Library
pg. 49

S&T TEST REPORT

Juno 12.5 Equatorial Telescope

Jupiter Telescope Co., Inc.
810 Saturn St., Suite 16
Jupiter, FL 33477
407-694-1154

$2,995 base price
(plus $170–$250 packing and shipping)

Portable and equatorial, the Juno 12.5 combines fine visual performance with easy setup and handling. But even though it tracks the stars, it's not for photography.

The Juno 12.5 Equatorial Telescope

ANY TELESCOPE is a bundle of tradeoffs: between aperture and portability, price and quality, performance and convenience. Choosing a telescope wisely means making the best tradeoffs for your living situation and interest in astronomy.

In recent years buyers have considered portability to be more and more important, as spreading light pollution sends observers to their cars and as aging baby boomers develop bad backs. At the same time aperture fever remains at an all-time high. Meanwhile concern for high-resolution, high-contrast optical performance is also on the rise, a backlash against the mediocre optics that proliferated in the 1980s. Light pollution plays a role here too. It's prompting observers to spend more time on the planets, which suffer the worst from less-than-excellent lenses and mirrors.

So you say you want large aperture with sharp resolution and good portability on a sturdy mount at a moderate price?

The Juno 12.5 is a great portable scope, providing big-aperture performance in a manageable package. It is based on innovative design, solid workmanship, and — no small consideration — apparently good quality control over the optics.

You're probably thinking of a big, short-focus Dobsonian with a first-rate mirror that's supported in a well-designed cell. But now you face new tradeoffs.

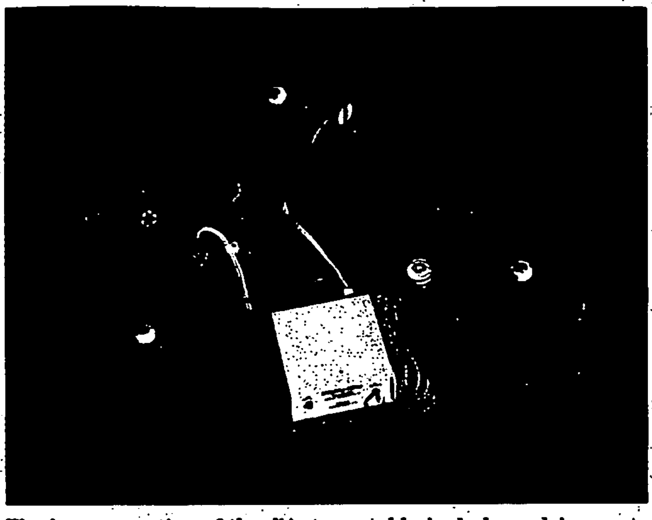
Only at high powers do you see the benefits of diffraction-limited or better optics. A Dobsonian mount, however, is an altazimuth that doesn't track the stars; at high powers you have to push it along every few seconds. Moreover, a short-focus reflector such as an f/4.5 suffers from coma as soon as you look away from the optical axis. You have to keep the main mirror in excellent collimation *and* keep your target in the "sweet spot" at the middle of the view if you want diffraction-limited performance. This means a Dobsonian must be pushed almost constantly. So the mount's motions had better be extremely smooth and controllable.

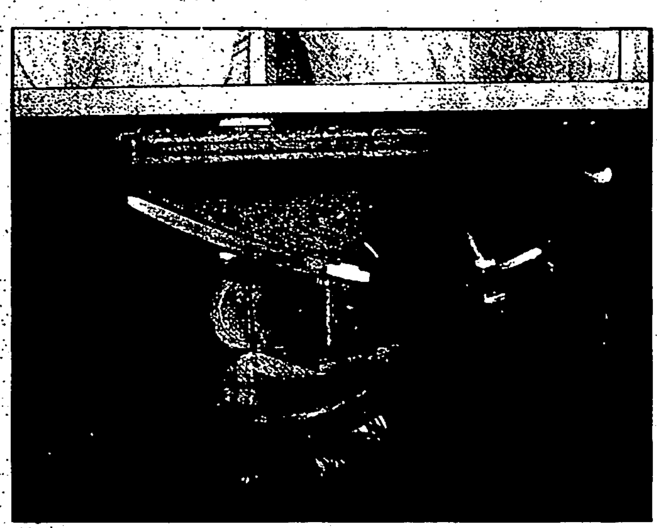
It sure would be nice to have a Dob's big aperture and portability on a clock-driven equatorial mount. Amateur telescope makers have invented various designs to achieve this. Perhaps the most elegant is the d'Autume table, described by Georges d'Autume in *Sky & Telescope* for September 1988, page 303. A patented version of it sits beneath the Juno line of Dobsonians sold by Andy Johnson of the Jupiter Telescope Company.

GETTING ASSEMBLED

The Junos come in apertures of 12.5, 15, 18, and 22 inches. All are f/4.5. I tested the 12.5-inch, the most portable and least expensive and the only one with a solid wooden tube.

Initial assembly went smoothly, and the instructions were clear enough. The





The bottom section of the d'Autume table includes a drive controller and a motor on one of the three pairs of roller wheels. Two of the weight-bearing wheels are steel; the drive roller is a heavy, slightly pliable plastic.

job ought to take one or two people no more than an hour. You end up with five pieces that go together and come apart in a snap for transport and setup.

Two flat pieces form the d'Autume table. It was hard to believe that this 22-pound sandwich, standing only 8 inches off the ground, was the equatorial mounting for a 12- or 15-inch telescope. Compared to old ideas of equatorial mounts, it is a marvel of simplicity, ingenious design, and precise fit, despite its home-workshop look and feel.

The heaviest piece is the main tube containing the 2-inch-thick Pyrex mirror. The tube's normal weight of 38 pounds was boosted to 44 by an extra sliding counterweight, plus an additional lead weight on the opposite side to counter the counterweight, because the buyer said he planned to use a 20-mm Nagler eyepiece. Heavy eyepieces like this require several times their mass in counterweights at the bottom end of a Dobsonian. The weights provided were still not quite enough. A lighter and better solution would be removable weights just inside the back of the tube. If you plan to use heavy eyepieces, say so when ordering.

Five wooden pieces make up the Juno 12.5. The largest and heaviest is the main tube section, which fitted in the back seat of the author's Geo Prizm. The rocker box also went in the back seat, nested over one end of the tube with a blanket for padding.

Another counterweighting problem will be a finderscope, if you add one. Johnson doesn't supply finders; Junos come only with a lightweight Telrad reflex sight, which works great for targets you can see with the naked eye. To locate almost anything else you do need a finder, unless you're willing to make long, laborious star-hops from a naked-eye landmark using a highly detailed atlas such as *Uranometria 2000.0*. Alternatively, as a $550 option, you can order the Sky Commander digital setting circles with a database of 4,500 objects.

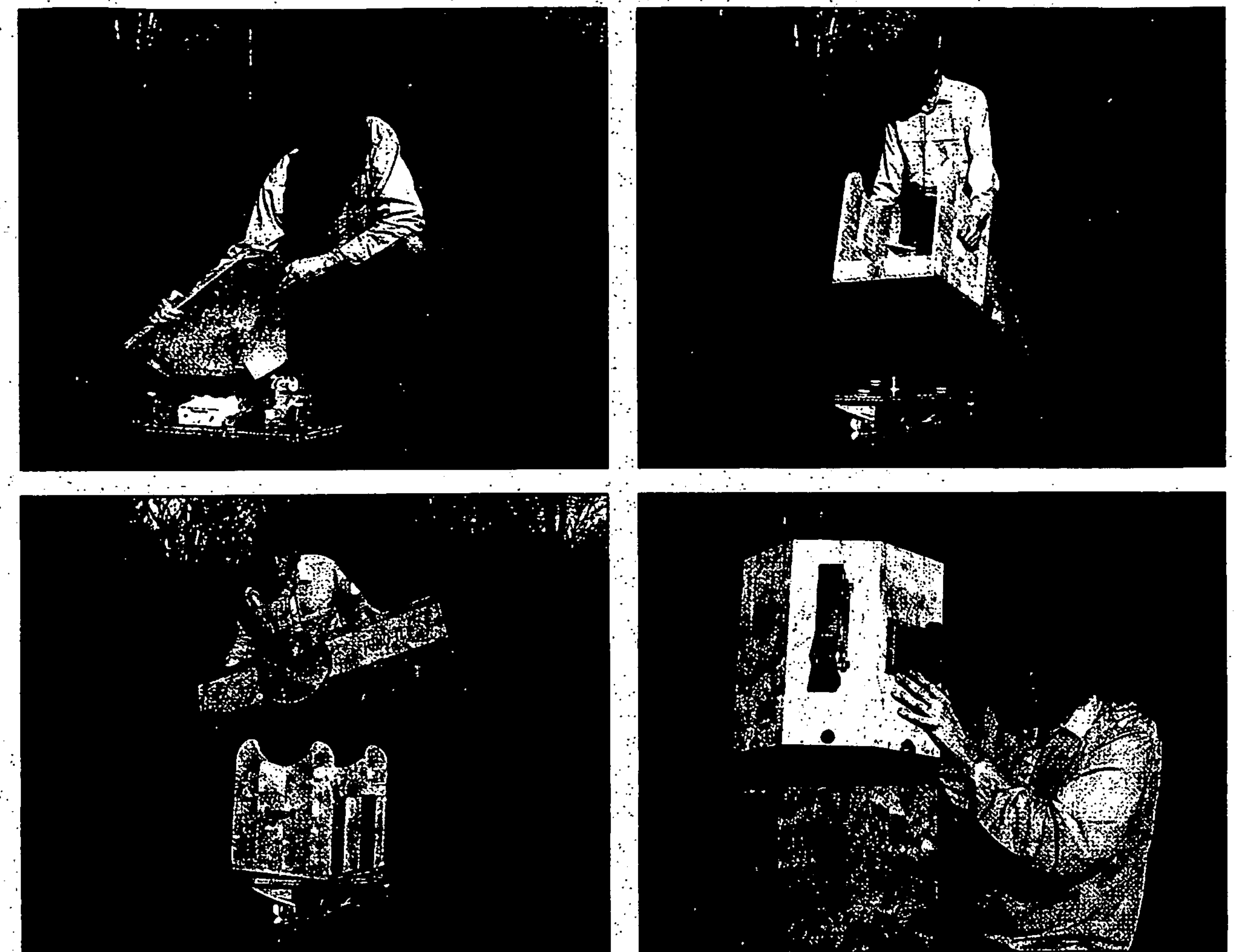
The Juno's woodworking was very good home-workshop grade. The polyurethane finish, on clear birch plywood, was rough to the touch; it could have used more coats and sanding.

TRYING IT OUT

My own 12.5-inch reflector is an f/6 on a traditional German equatorial mount. It was described in the December 1992 issue, page 696, and provided an enlightening basis for comparison with the Juno.

The most obvious difference was portability. The disassembled Juno fits (with some stacking and padding) in the back seat and trunk of a small sedan; I felt an exciting rush of freedom at the thought of escaping with it to anywhere. It took only a couple of minutes to set up next to the f/6 in my observatory. The job hardly raised a sweat and will be no hassle if you have normal adult strength and a good back.

At first look the views in both telescopes were very much alike — but the



Top left: **The top section of the d'Autume table has three heavy aluminum blocks whose surfaces, machined as a unit, form sectors of one large cone whose invisible centerline is the polar axis. They rest on the rollers.** ***Top right:*** **The rocker box fits onto the d'Autume table by a shaft closely machined to eliminate side motion.** ***Bottom left:*** **Lifting the 44-pound main tube section into place.** ***Bottom right:*** **Four chest latches snap the tube sections together to finish setup.**

Juno handled almost as easily as a 6-inch. The eyepiece was low enough for a tall child to see into at most positions, and I actually had to sit or stoop.

Running the d'Autume table proved as simple as could be — turn on the switch and forget it. The scope works like a regular Dobsonian, except that objects don't budge from the center of view. After about 70 minutes the drive cuts off; you reach down, loosen a knob, shove the table a few inches on its rollers to reset it, and retighten the knob.

With time, however, more subtle issues came out. To get independent opinions I invited others to perform side-by-side tests. These included *Sky & Telescope*'s Stephen J. O'Meara as well as members of the Amateur Telescope Makers of Boston: past president E. Talmadge Mentall, Bob Beckley, and professional optician Phil Rounseville.

Johnson gets mirrors for the Junos from several makers; customers with a preference can choose who they want. He says he star-tests all the mirrors outdoors, and he guarantees them to ⅛-wave peak-to-valley surface accuracy (¼-wave on the wavefront) with good smoothness. He will also build a Juno around a customer's f/4.5 mirror.

My own f/6 mirror, an excellent one by John Hudek of Galaxy Optics, is very smooth but does show some spherical aberration when a cool night follows a warm day. We used Clavé Plössl eyepieces providing identical high powers on the two scopes. The Juno nicely passed the in-and-out (either side of focus) star test for spherical aberration, astigmatism, and zones, but several people remarked that the mirror seemed less smooth than the f/6; the "piles of light" of stars at very high power were slightly less clean and compact, displaying more ragged edges. The f/6 also did a little better on the Seyfert galaxy NGC 3227, M51, and the craterlets on the floor of Plato, though this required a lot of comparing. Surprisingly, the object that showed the least difference between the two scopes was Jupiter, a critical test of smooth, high-contrast optics.

In any case, the small differences between the mirrors were usually overwhelmed by atmospheric seeing and tube currents. As commercial mirrors go the Juno's was basically fine.

Surprisingly, sky darkness was just as good in the f/4.5 Juno as in the f/6, even with the latter's specially blackened and lengthened tube. This was true for detecting both the faintest stars in a dark field and the earthlit limb of the gibbous Moon. Apparently the Juno's internal

tube rings work well as light baffles.

Collimating the main mirror was easy using the optional (and highly recommended) Cheshire eyepiece. Only minor touchups were then required on a star. You do have to recollimate slightly every time you take the front section off the tube.

The telescope's Dobsonian motions (Teflon on pebbled Ebony Star laminate) were somewhat stiff and jerky even after lubrication with furniture wax as recommended in the instructions. But there was no backlash, and vibrations in the wooden structure damped out almost instantly.

The Dobsonian rocker box had a slightly grating design flaw. Because the d'Autume table spends most of its time tilted, a large, plastic side bumper on the telescope tube rubs against the rough, polyurethaned inside of the box. This made a scratching noise when the telescope was moved in altitude and added to the stiffness. Laminate belongs on this bearing surface.

The d'Autume table does have important shortcomings compared to a regular equatorial. The telescope's motions do not define east-west and north-south in your field of view, an immense benefit for finding your way around. Each table has to be machined for the customer's latitude; a big adjustment screw allows for use 5° north or south of the latitude intended. And polar alignment is a conundrum. The bottom board comes with a compass and a bubble level; after you learn your local magnetic deviation from true north and carefully calibrate the compass, these tools should quickly get you to within a few degrees of the pole. That's fine for visual work and probably enough for the Sky Commander. Better polar alignment requires the time-consuming star-drift method; these scopes are not a good choice for astrophotography.

SUMMARY

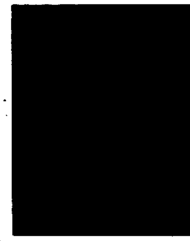
The Juno 12.5 is a great portable scope, providing big-aperture performance in a manageable package. It is based on innovative design, solid workmanship, and — no small consideration — apparently good quality control over the optics. If you want a big, easy-to-handle, quality scope for car transport and visual use, especially by older kids, it's a winner. But do add a finder. If you're thinking of a permanent installation, astrophotography, or CCD work, your tradeoffs are best made elsewhere.

ALAN MacROBERT

SINNOTT'S SLANT

By Roger Sinnott

"Sun, Stand Thou Still . . ."



IMAGINE a flat surface cleverly motorized to make the Sun, Moon, and stars stand still, exactly as if Joshua had reissued his biblical command. Plunk down a telescope and see the field of view freeze. Bring over a camera on a tripod and take a time exposure of the sky. Make the surface big enough, perhaps parking-lot size, and you can entertain a whole star party without the need for individual clock drives.

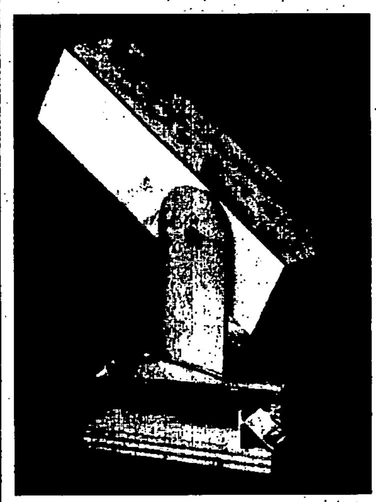
For all its utility, the equatorial table is a very recent concept in the history of telescope making. It dates from a short piece by Adrien Poncet in the January 1977 *Sky & Telescope*. This eccentric French poet, then 76 years old, had failed to get his article published in Europe and was so thrilled when it appeared in *Sky & Telescope* that he shipped us two cases of Vin Fou from a neighbor's vineyard! Interest in the Poncet platform spread as telescope makers grasped the radical notion of an equatorial mount with no polar shaft.

Then spake Joshua . . . ,

"Sun, stand thou still upon Gibeon; and thou, Moon, in the valley of Ajalon." And the sun stood still, and the moon stayed . . . in the midst of heaven.

Joshua 10:12–13

A decade later Andy Saulietis and Al Kelly of NASA were using CAD software to design a new type of motor-driven table, one in which four segments of a single fat cone ride on a pair of long and skinny conical rollers. I saw their impressive unit under a 32-inch reflector at the 1989 Texas Star Party (*S&T:* December 1991, page 661). Quite independently and a little earlier, Poncet's countryman Georges d'Autume invented a class of tables wherein sections of a cone are supported on cylindrical rollers. This is the approach taken by the Jupiter Telescope Co. in their Juno line.



Poncet's first equatorial table.

While examining the 12.5-inch Juno, I was struck at how handy the 22-pound table itself would be for a trip to any latitude within 5° of that for which it was built. This table could have helped me at the May 10th annular eclipse, or in a frantic dash to dark skies to photograph a newfound comet. It can fit in the smallest car trunk or a large suitcase. The upper surface measures 19 by 24 inches, ample room for carrying a whole array of meteor cameras pointing around the sky.

Is the end in sight? Have all possible varieties of equatorial table been discovered? I thought so until Donald W. Davies of Torrance, California, opened a whole new category in *ATM Journal* #3 published last year. In Davies's concept the upper table has four casters that roll on the plane sides (no curves) of four pyramidal blocks, which can be cut with a radial-arm or compound miter saw. He built this mount for a 17.5-inch reflector just to convince the skeptics, one of whom was Davies himself. It works.

Each month Roger Sinnott takes a close-up look at the ever-expanding world of astronomical products and how well they meet observers' needs.

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03940899 (THIS IS THE FULLTEXT)
The Endemann effect: A new concept in high-power optics
Endemann, Thomas R
Sky & Telescope (GSTN), v96 n5, p121-126, p.6
Nov 1998
ISSN: 0037-6604 JOURNAL CODE: GSTN
DOCUMENT TYPE: Feature
LANGUAGE: English RECORD TYPE: Fulltext; Abstract
WORD COUNT: 3444

ABSTRACT: Endemann discusses how he developed a concept for high-power optics with exceptional qualities for planetary viewing. A tiny spherical secondary produces an extreme form of Cassegrain reflector.
TEXT:

Headnote:

A tiny spherical secondary produces an extreme form of Cassegrain re flector - one with exceptional qualities for planetary viewing.

(Photograph Omitted)

Captioned as: Above: The author's 8-inch reflector sometimes works as an f/4 Newtonian, with its focus where the camera is **mounted** in this view. But if he replaces the Newtonian diagonal with a small-diameter convex secondary, the instrument is transformed into what he calls a Planetary Astrographic **Telescope** (PAT), whose f170 focus may be viewed by the eyepiece behind the main mirror cell. He supplied all illustrations for this article. Left: To photograph the planets, most amateurs need a projection lens (eyepiece or microscope objective) to enlarge the image. Not Endemann. He recorded Saturn in this 3-second exposure at the f/70 focus of his PAT. The ring system extends more than 3 millimeters on the original Kodak Elite II 400 transparency.

IN 1993 I HAD MY 8-INCH F/4 MIRROR checked out by Dan Joyce, the wellknown Illinois **telescope** maker. I was getting good numbers on my homemade Foucault tester. I had made two f/8 mirrors before, a 6- and an 8-inch, but this one was to be special. At least 170 hours went into the figuring. My idea was to let Dan check it out and then perhaps do any final retouching in the shop he had at the time.

I remember the day as though it were yesterday. I was at Astrofest '93, held near Kankakee, Illinois, and spent the better part of the day visiting the stands set up for people to sell their wares, admiring the many homemade instruments, and occasionally looking to spot Dan. We finally got together in the evening and he gave me the good news. To my utter delight, the mirror checked out at 1/10 wave! Dan said that if I could finish an f/4 mirror to such a tolerance I didn't need his shop.

I was so happy that after I left the convention I drove about 20 miles in the wrong direction before I realized the error. Finally making it home about 11 p.m., I awakened my wife of 32 years to report the triumphant news. She exclaimed, "That's wonderful!" and went immediately back to sleep. But that was just the start of a five-year journey. The result, described in this article, is what I call a Planetary Astrographic **Telescope**, or PAT for short.

The Design Evolves

From the start I had a combination Newtonian-Cassegrain **telescope** in mind. So the primary mirror already had a central hole when I assembled the **telescope** initially as a Newtonian. I wanted to be able to swap out the diagonal mirror for a Cassegrain secondary whenever I needed a truly high-power system. But after two years of struggling to make the convex hyperboloidal mirror called for in a Cassegrain, my patience had grown very thin.

Then one night I came across an interesting passage in Jean Texereau's How to Make a **Telescope**. While discussing a particular high-focal-ratio Cassegrain, he remarked (at the bottom of page 154) that the amount of material to be removed from the secondary mirror was very

slight. In other words, the required hyperboloid hardly differed at all from a sphere - the easiest of all surfaces to figure.

The seeds of an idea had been sown. But I was still thinking in terms of a hyperboloid when a little luck intervened. As an experiment I sent an old 1-inch convex lens out to be aluminized. When it came back I inserted it in the **telescope**'s Newtonian drawtube so the convex side would reflect the light back to the Newtonian diagonal and then through the hole in the primary mirror. By racking the Newtonian focuser in and out, I found a position that produced a whopping f/60 at the Cassegrain end of the **telescope**!

That night I turned the scope on Saturn. Instead of an eyepiece, I used a Nikon camera body at the Cassegrain focus as a convenient right-angle viewer. To my delight, I saw Saturn with more definition than I had ever before mustered with this instrument. This was all the more surprising, given the presence of the large diagonal, whose 2.6-inch minor axis obstructed 32.5 percent of the 8inch aperture. Fine planetary performance is not normally associated with a large central obstruction.

I went back to figuring and testing several possible secondary mirrors for my **telescope**. But after two more weeks I was again on the verge of throwing in the towel - nothing seemed to be going right. Suddenly I remembered that wonderful view of Saturn. It occurred to me that the aluminized lens probably had a spherical figure, and I recalled Texereau's comments as well. Did I really have to shoot for a hyperboloidal secondary when I had gotten such a fine image with a spherical convex mirror?

I went to my workroom and searched for the sacred piece, but I couldn't find it anywhere. I did locate another convex element of 1-inch diameter, one of the small secondaries I had been working on. (I had set it aside earlier, discouraged by optical tests, but there was a chance those tests had been wrong.) Instead of putting it in the Newtonian drawtube, as before, I took the time to machine a proper holder for this ultrasmall secondary from PVC pipe. Then I removed the large diagonal and installed this device in its place. Carried on a plexiglass stem, the secondary's longitudinal position was easy to **adjust** by as much as 2 inches to bring the light to a sharp focus behind the primary mirror.

My first target of the night was the famous Double-Double star, Epsilon (epsilon) Lyrae. This time the focal ratio was f/70, and to think of it in better perspective, imagine an 8-inch **telescope** with a tube almost 50 feet long! I aimed it at the target and inserted a 40-millimeter eyepiece giving 355x. After focusing on the southern, more equal pair of this multiple system, Ez with a separation of 2.3 arcseconds, I found the image to be textbook perfect - you could drive a truck between the components. Just as spectacular was the northern pair, E1, which has a 1.1-magnitude difference in the components' brightnesses.

(Photograph Omitted)

Captioned as: For videotaping the planets, Endemann **mounts** the camera squarely behind the eyepiece on a special L bracket. Note the brass handle at upper right for carrying the tube.

(Photograph Omitted)

Captioned as: The 8-inch reflector's 47-foot focal length almost rivals that of the great 40-inch Yerkes refractor (63.5 feet). Its mammoth tailpiece is seen behind the author in this view, taken inside the observatory's dome at Williams Bay, Wisconsin.

That was the beginning of the most memorable night I have ever spent with this instrument. I placed my homemade binocular viewer on it and the doubles seemed to jump out at me. For the topper of the evening I zeroed in on the planet Jupiter.

Then I tried something interesting. To bring down the enormous power of the system, I installed a surplus camera lens, a Tessar of 5-inch focus, as a focal reducer in the 2-inch drawtube of my turretlike rack-and-pinion focuser. Since the reducer's lens barrel was 1.24 inches in diameter, I **mounted** it on a short sleeve of 2-inch (outside diameter) PVC tubing. The latter was slid into the drawtube along with a strip of 0.020-inch brass shim stock in order to allow retrieving the device. The ends of this strip extended about 3/8 inch beyond either end of the adapter and were bent up slightly to allow the reducer's position to be **adjusted** with a pair of long-nose pliers.

I discovered something else about this system that I thought was unique. I removed the focal reducer and inserted it in the rear of my

baffle tube. What this did was change the Cassegrain end of the instrument into a kind of zoom system. In other words, with the focal reducer stationary, only the eyepiece had the ability to travel. With the drawtube all the way in I had 175x. With the drawtube extended, the magnification grew to 400x with just a minor tweak of the secondary mirror's longitudinal position.

Further innovations came in my pursuit to expand the instrument's capabilities. For instance, the Cassegrain baffle was **mounted** through the hole in the primary so its direction could be **adjusted** mechanically with three spring-loaded screws, independent of but in the same manner as the primary mirror.

Up to this point I wasn't quite sure why my new optical system was working so well. After all, I was using a paraboloidal primary and a spherical secondary in a Cassegrain **telescope**, and that defied all the books I had read over the last 37odd years. Then, too, I recalled the discouraging title of a chapter in Albert G. Ingalls's Amateur **Telescope** Making series: "How to Make a Cassegrainian (And Why Not To)."

But it was Texereau who helped me understand why the spherical secondary worked so well. Applying his formula for the deviation of my secondary from a sphere, I got 0.0000022 inch and dutifully entered this number on the large-scale drawing on my drafting table. There was something familiar about that number, and then it hit me like a ton of bricks. One wavelength of visible light is very nearly 0.000022 inch, and my value had one more zero. My spherical secondary was accurate to 0 wave!

Calculations by Art Vaughn (Jet Propulsion Laboratory) and Richard A. Buchroeder (Optical Design Services) have confirmed this result, validating the system's performance. I have also looked at similar designs with primary mirrors from f/4.5 to f/7. In each case there is a range of high focal ratios where the paraboloidal primary can be teamed with a spherical secondary; I call this range the "spherical zone."

(Table Omitted)

Captioned as: Specifications of the PAT

(Photograph Omitted)

Captioned as: Right: The long baffle tube at left is inserted through the perforation of the primary mirror to block stray starlight from reaching the Cassegrain focus. This baffle has a 1/2-inch diaphragm at the top, ensuring that no light gets to the eyepiece except that reflected by the secondary mirror.

Below: The large flange on the baffle's lower end serves for attaching it to the plate that also carries the primary mirror cell. Three small holes are for the spring-loaded screws that allow the baffle to be collimated independently of the primary mirror; the larger holes merely help with tube ventilation.

For me, the design's biggest attraction is that it allows high-resolution planetary photography without the need for a projection lens of any kind -just two simple reflections.

The **Mount**

To carry the **telescope** I started with a Meade Starfinder **equatorial mount** but made a few modifications of my own. I removed the Teflon **bearings** from the polar axis and replaced them with three different **bearings**. First I bored out the base at the motor end of the shaft housing, where one of the Teflon **bearings** was originally installed, and inserted a needle **bearing** of 1-inch inside diameter. Second, I placed a ball **bearing** at the upper end of the same housing where the other Teflon **bearing** had been.

Both of these jobs required my lathe and would be dangerous for anyone except an experienced machinist to attempt. But the third modification is something any owner of a Meade Starfinder **mount** could perform. This **bearing** is of the lazy Susan variety, obtained from a hardware store. It goes between the declination and polar housings, as illustrated above. It removes almost all the friction at this juncture, whereas any normal lubricant could thicken, especially on cold nights. No lathe was needed in this operation; the spacer was all I had to make. But I also advise adding a plastic dust shield around the gap between the housings created by the new **bearing**.

The elevating pier of my **telescope** was purchased at Astrofest '93 and needed some modification. For example, the braces that supported

the central column had to be lowered and placed on wheel supports to provide greater rigidity. The key aspects of this device are shown in the upper cutaway drawing on page 126. With it, the instrument can be raised and lowered with ease, placing the eyepiece at any convenient height. The large tube that supports the lazy Susan shelf is the male end of a 10-inch PVC drainage pipe.

The harness system I designed for the **telescope** tube was crafted from the same piece of PVC that supports the lazy Susan. I had to split the tube and line the inside with self-adhesive felt strips. I then added an extra supporting plate of the same PVC, about the same size as the saddle that the Meade **mount** came with. This plate was simply attached to the harness with Krazy Glue and held in place for a few minutes. The entire assembly is bolted to the saddle with two large Y8-inch wing nuts and washers.

Later I designed a brass handle for the harness, visible in the photographs on pages 121 and 122. Without a handle the 35-pound tube was very awkward to lift. Before bending a 4-inch brass rod to the final shape, I measured it to the proper length and threaded both ends on my lathe. Next I machined two collars from 1W4-inch brass, tapping them out to accept the 1/4inch threaded rod. The rod was then bent and the collars added.

Next I prepared the harness to receive this handle. I used a 1 1/4-inch Forstner bit to bore two flat spots precisely where the ends of the handle would go, then marked and drilled the holes in the PVC. A Dremel tool with a 1/8-inch router bit was used to carve out the small recesses on the inside of the harness where the nuts and washers would be countersunk. The entire assembly was then masked off and spray-painted with white epoxy.

The main tube is made of aluminum, 10 inches in diameter with a 0.050-inch wall. I bought it from a company that builds tanker trucks. They use this tubing to haul their hose sections. I paid $15 in 1994 - a fact that might interest anyone looking for a 10-inch-diameter **telescope** tube!

As purchased the tube was 8 feet long, and I used only 33 inches of it in this project. The hole for the Newtonian drawtube and the **mounting** holes for the primary mirror assembly were then cut, and I installed a ring of birch plywood for reinforcement at the tube's front. This ring is 1/4 inches wide radially, and I glued 3/4-inch-thick laminate birch to its outer edge. The plate at the Cassegrain end is made from the same material.

Among my other finds at Astrofest '93 was a brass porthole that once adorned a yacht. This I machined to serve on the rear end of the **telescope** as a supporting collar for the focuser and other attachments. It also holds the three 10-32 screws used to collimate the primary mirror.

(Photograph Omitted)

Captioned as: To help the heavy **telescope** turn more freely the author replaced the Teflon **bearings** in his Meade Starfinder **equatorial mount**. Pictured here is the simplest and most effective of these upgrades, a lazy Susan **bearing** (with corners clipped off) that he placed on the polar shaft with a spacer ring to keep the **bearing** centered.

(Photograph Omitted)

Captioned as: The convex secondary mirror is carried in an aluminum collar fitted with Allen screws for collimation. One advantage of the spherical figure is that this secondary has no optical axis (unlike a hyperboloid). The screws are used to tilt or translate the secondary until its center of curvature coincides with the primary mirror's optical axis.

The inside of the **telescope** tube is lined with Y8-inch cork. I also machined a set of 10 baffle rings from 1/4-inch foam core on my lathe. For this operation I clamped a Stanley blade to the lathe's cross slide, enabling the rings to be cut in a very precise manner. After installing these baffles in the tube, I spray-painted the interior with flat black.

The drive control was installed in a special cabinet that hangs on the side of the pier. Best seen in the lower picture on page 122, this cabinet can swing from side to side, something that I accomplished with a surplus lens cell made from anodized aluminum. I had to machine the top of the pier's central column in order to fit the cell's inner ring, which was then secured with three Allen setscrews. The outer cell had a nice flat flange that I bolted to the upper 3/4inch-thick solid oak plate with six 8-32 brass screws, nuts, and washers.

(Illustration Omitted)
Captioned as: Illustrating the **telescope**'s Cassegrain configuration, this diagram omits the Newtonian drawtube and diagonal. Note that the central obstruction in a Cassegrain is determined by the secondary holder, the perforation in the primary, or the end of the baffle tube in the converging rays, whichever has the largest effect. The letters in this diagram match those used in Chapter 6 of Jean Texereau's How to Make a **Telescope**.

This assembly is connected to the drive-control cabinet with two brass **hinges** so the cabinet can be lifted over the locking knob for the central column when the scope is in its lowest position. The **hinges** are primarily used when I want to connect or disconnect various electronic plugs. In addition, the assembly protects the electronics from excessive moisture and keeps the cables out of the way. The brass door was made from small brass channels and angles from the local hardware store.

For use as a high-power finderscope, I purchased a 60-mm Tasco refractor at a secondhand store for $15. I junked its original rack-and-pinion apparatus and added a 1 1/4-inch brass drawtube that slides within a felt-lined brass collar that I made on my lathe. The diagonal mirror on this finder came from American Science Center in Milwaukee, Wisconsin, where I was told it came off a World War I tank sight. It did not look like much, covered in olive drab paint, but by removing the old paint and polishing the brass I really spruced it up. It already had a nice reticle, and I installed a red lightemitting diode to light up the grid lines. The diode is powered from my drive control, which has a dimmer control on it.

In concluding, I must state that my goal in astrophotography has been to attain the finest possible images, especially for planetary work. I believe my optical design is quite conducive to this end. Some of the credit must go to Will Rogers's famous line, "Don't believe everything you read." To this I would add, "Investigate on your own, and never be afraid to challenge a previous conclusion." I would like to thank my entire family, without whose support this project might never have been completed.

(Illustration Omitted)
Captioned as: The author purchased his homemade elevator pier at Astrofest '93 and then made a number of improvements. For **adjusting** the **telescope**'s height he installed hefty helical gears from a drill-press table. He also added two compression gas tubes, the same kind used to lift the hatchback of a car. They relieve 60 percent of the thrust needed when he is raising and lowering the **telescope**. Using the crank, he can set the top of the column anywhere from 30.6 to 45.4 inches above the ground.

(Illustration Omitted)
Captioned as: The secondary holder consists of a PVC housing on a plexiglass stem, which is joined to a mahogany footing with 5-minute epoxy that was then **contoured** with sandpaper on a dowel. For coarse collimation, the footing can pivot around the vertical 8-32 screw that holds the parts together. The aluminum rod extends the length of the **telescope**, emerging at the focusing knob behind the tailpiece.

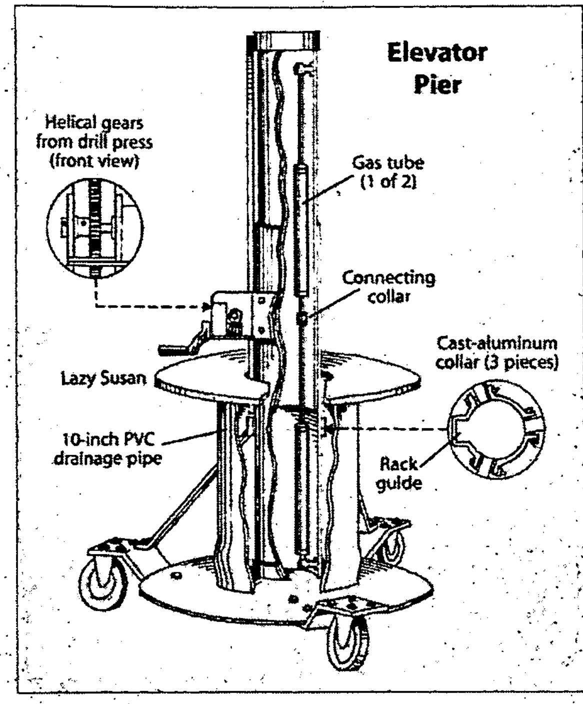
Reference:
Further Reading
Reference:

Ingalls, Albert G. Amateur **Telescope** Mak ing 1, 2, and 3. Richmond, VA: WillmannBell, 1997.

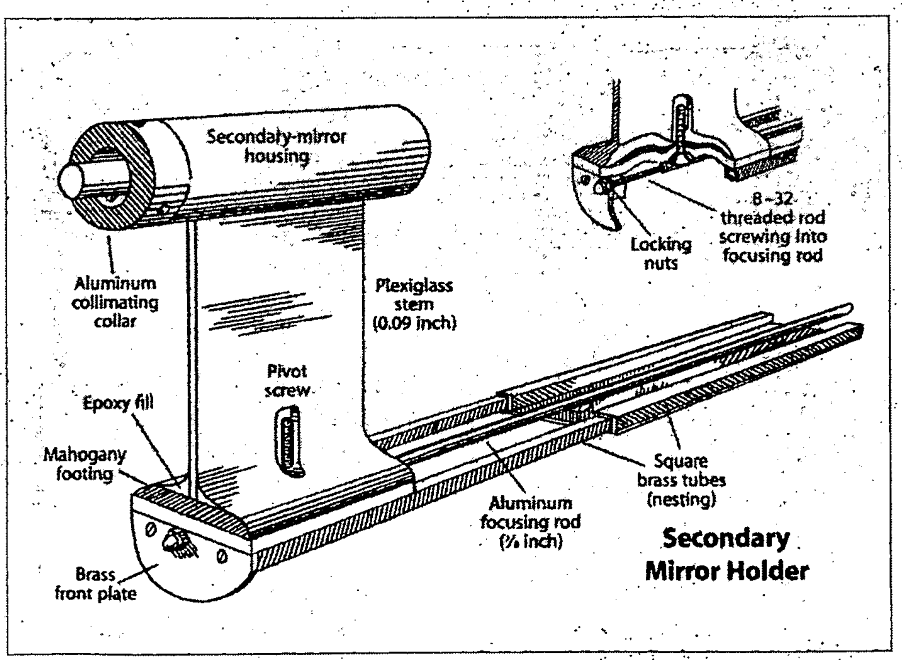
Suiter, Harold Richard. Star Testing Astro nomical **Telescopes**. Richmond, VA: Willmann-Bell, 1994.

Texereau, Jean. How to Make a **Telescope**, 2nd English edition. Richmond, VA: Willmann-Bell 1984.

Author Affiliation:
THOMAS ENDEMANN, whose address is P.O. Box 281, Lake Geneva, WI 53147-0281, is a custom woodworker by profession, designing and building such items as the apparatus used by magicians. He has filed a patent application with the U.S. Patent Office concerning several key features of this **telescope**. While hobbyists can experiment with the ideas presented here, nothing in this article gives a license to manufacture, use (in the legal sense), or sell this type of **telescope** without the author's express written consent.



Elevator Pier
Helical gears from drill press (front view)
Gas tube (1 of 2)
Connecting collar
Cast-aluminum collar (3 pieces)
Lazy Susan
10-inch PVC drainage pipe
Rack guide



Secondary-mirror housing
8-32 threaded rod screwing into focusing rod
Locking nuts
Aluminum collimating collar
Plexiglass stem (0.09 inch)
Pivot screw
Epoxy fill
Mahogany footing
Square brass tubes (nesting)
Aluminum focusing rod (⅜ inch)
Brass front plate
Secondary Mirror Holder

The Endemann effect: A new concept in high-power optics
Thomas R Endemann
Sky and Telescope; Nov 1998; 96, 5; Research Library
pg. 121

The Endemann Effect: A New Concept in High-Power Optics

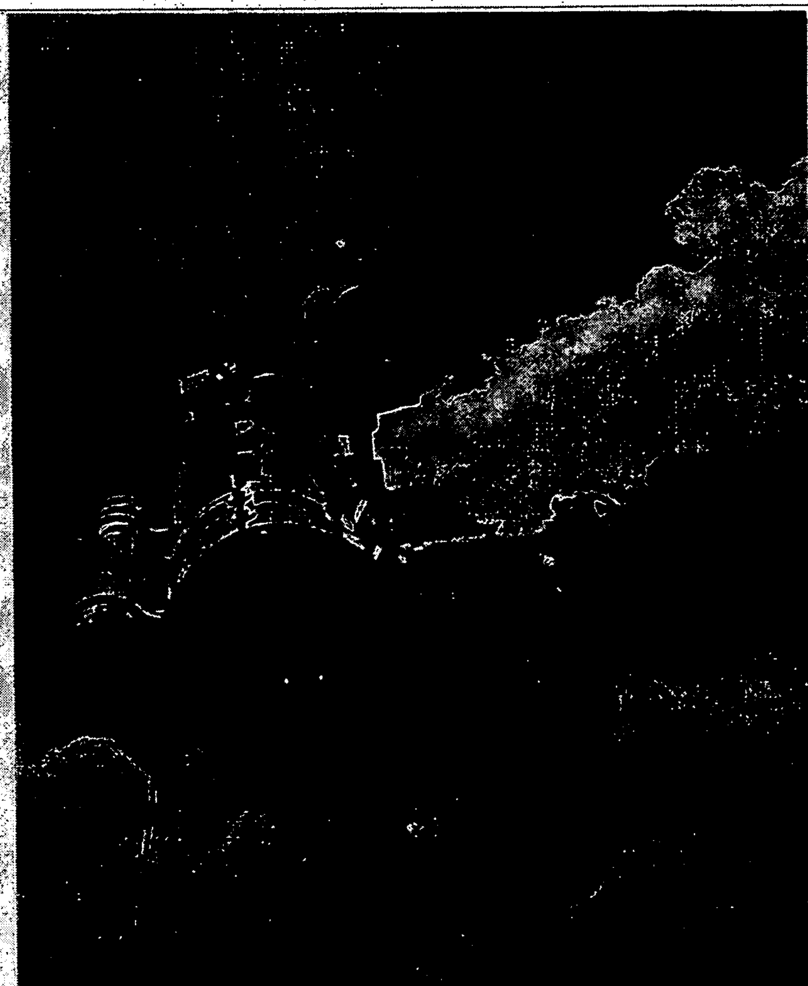
A tiny spherical secondary produces an extreme form of Cassegrain reflector — one with exceptional qualities for planetary viewing.

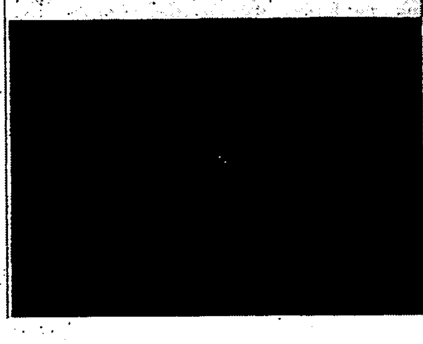
By Thomas R. Endemann

IN 1993 I HAD MY 8-INCH F/4 MIRROR checked out by Dan Joyce, the well-known Illinois telescope maker. I was getting good numbers on my homemade Foucault tester. I had made two f/8 mirrors before, a 6- and an 8-inch, but this one was to be special. At least 170 hours went into the figuring. My idea was to let Dan check it out and then perhaps do any final retouching in the shop he had at the time.

I remember the day as though it were yesterday. I was at Astrofest '93, held near Kankakee, Illinois, and spent the better part of the day visiting the stands set up for people to sell their wares, admiring the many homemade instruments, and occasionally looking to spot Dan. We finally got together in the evening and he gave me the good news. To my utter delight, the mirror checked out at 1/10 wave! Dan said that if I could finish an f/4 mirror to such a tolerance I didn't need his shop.

I was so happy that after I left the convention I drove about 20 miles in the

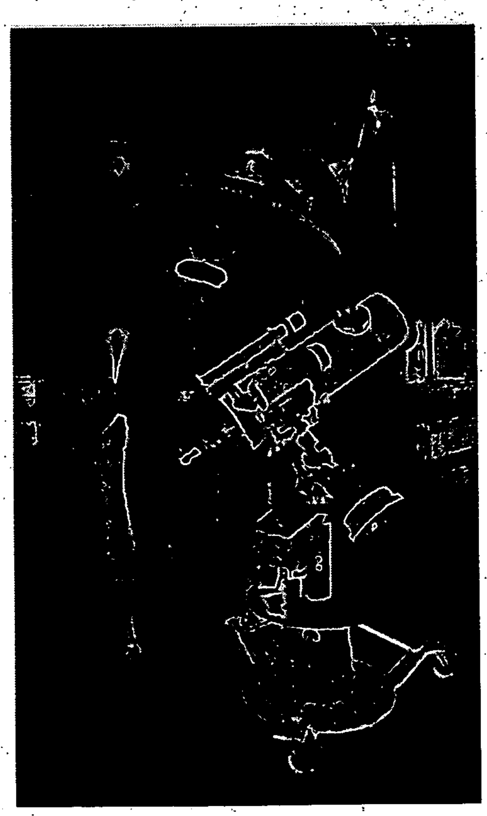




Above: The author's 8-inch reflector sometimes works as an f/4 Newtonian, with its focus where the camera is mounted in this view. But if he replaces the Newtonian diagonal with a small-diameter convex secondary, the instrument is transformed into what he calls a Planetary Astrographic Telescope (PAT), whose f/70 focus may be viewed by the eyepiece behind the main mirror cell. He supplied all illustrations for this article.

Left: To photograph the planets, most amateurs need a projection lens (eyepiece or microscope objective) to enlarge the image. Not Endemann. He recorded Saturn in this 3-second exposure at the f/70 focus of his PAT. The ring system extends more than 3 millimeters on the original Kodak Elite II 400 transparency.


SONY

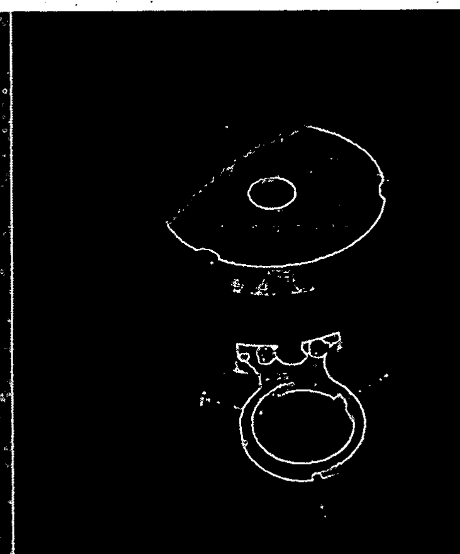


Specifications of the PAT

(All dimensions are in inches)

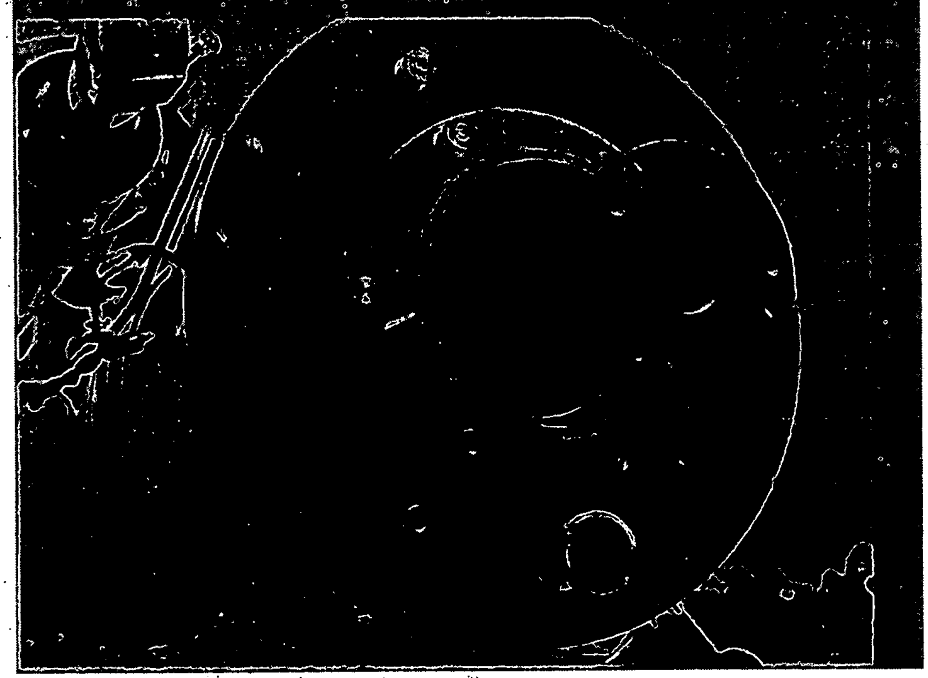
[illegible] paraboloid)	
Diameter	8.00
Radius of curvature	64.00
Focal length	32.00
Distance to secondary	29.75
[illegible] sphere)	
Diameter	0.65
Radius of curvature	4.77
Distance inside prime focus	2.25
Distance to Cassegrain focus	39.75
[illegible]	
Equivalent focal length	560.0
Effective focal ratio	f/70
Cassegrain amplification	17.5x
Image scale	14.5 arcsec/mm

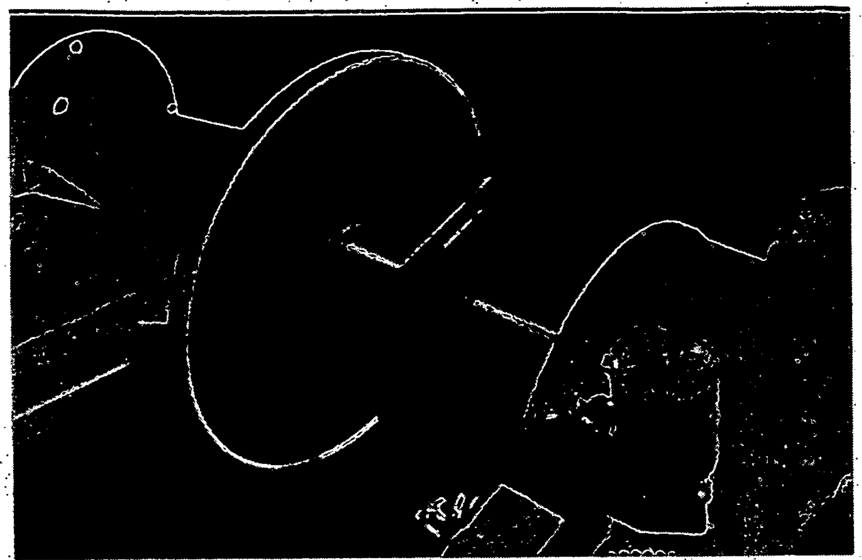
system's performance. I have also looked at similar designs with primary mirrors from f/4.5 to f/7. In each case there is a

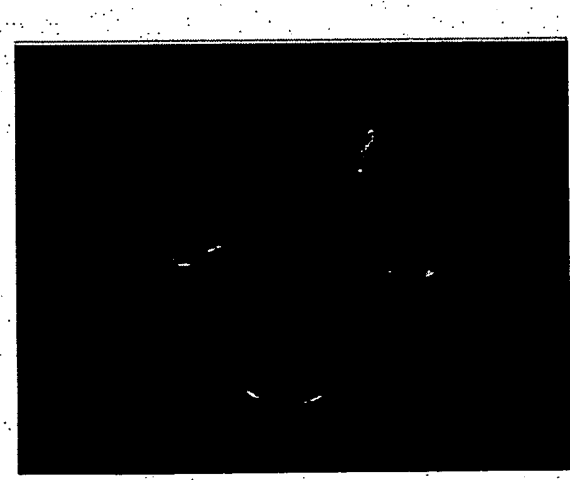


Right: The long baffle tube at left is inserted through the perforation of the primary mirror to block stray starlight from reaching the Cassegrain focus. This baffle has a ½-inch diaphragm at the top, ensuring that no light gets to the eyepiece except that reflected by the secondary mirror.

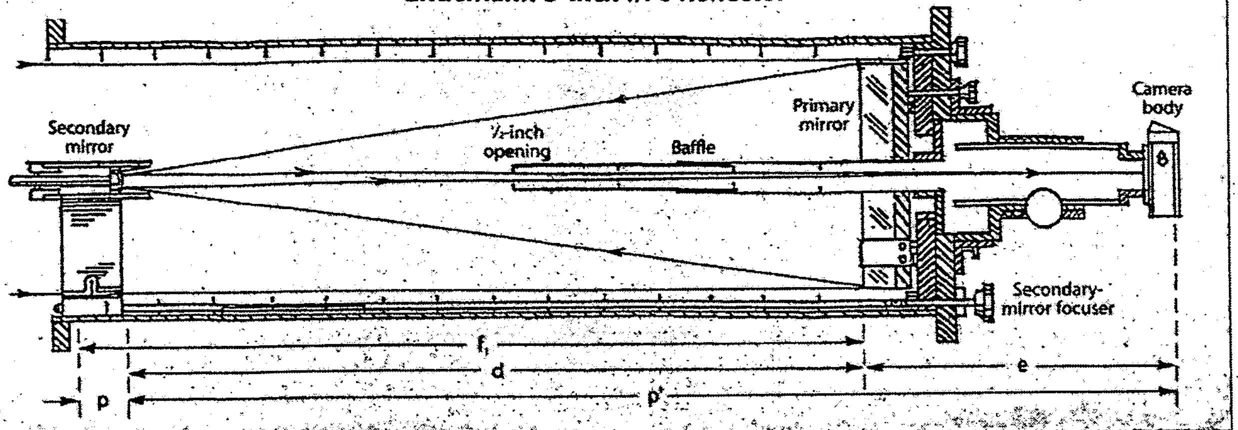
Below: The large flange on the baffle's lower end serves for attaching it to the plate that also carries the primary mirror cell. Three small holes are for the spring-loaded screws that allow the baffle to be collimated independently of the primary mirror; the larger holes merely help with tube ventilation.







Endemann 8-inch f/70 Reflector



Meet Christine
Alotis, Philip A
Sky and Telescope; Sep 1995; 90, 3; Research Library
pg. 74

Meet Christine

IN THE SUMMER of 1991 I decided to build my own planetary telescope. When my wife, Mary, learned that it would be a 12½-inch f/7 reflector, and that I planned to keep it in the living room, she suggested that I should "make it look as if it belongs there." The challenge was then to build an instrument that would go well in our 1902 Victorian house with its oak floors, glass doorknobs, and brass fixtures.

Perhaps influenced by maritime tradition, we soon found ourselves saying "her" instead of "it" when talking about the telescope. We named her Christine. And while many telescopes look like space probes or laboratory equipment, Christine is different.

CONSTRUCTION TECHNIQUES

The hardwood design came together while I was grinding the primary mirror. By the time I switched from No. 80 to No. 120 grit I had already fed the first planks through the table saw. I ran the saw and router in the early evenings, or by day on the weekends, saving the late nights for quieter work on the primary mirror.

The tube was the first structural part made. I wanted ½ inch of clearance around the mirror to avoid vignetting, and I felt that the light baffles should be at least ¾ inch deep. That meant a tube with a 15-inch inside diameter. Strips of oak flooring were ripped on the table saw to just over ¾ inch width and beveled by just under 3° on each side. Sixty-five of these strips, glued edge to edge, would form a polygonal tube of 15¾-inch outside diameter.

To prepare the form I cut seven 15-inch disks and made a concentric groove 13½ inches in diameter most of the way through each one with a router. These disks were then center-bored to fit tightly on a length of thin-walled steel pipe (3-inch electrical conduit). With the disks spaced out along the pipe and the latter supported on sawhorses, I glued the oak strips in place to form the tube. I also installed walnut and mahogany accent strips and a maple "sighting rail" during this phase.

The strips were glued full length to each other and to the disks. Fast-setting adhesive held them in place while the slower-drying epoxy resin between the strips cured. Using this technique I could work quickly, without having to clamp each strip mechanically and without leaving screw holes in them.

Philip Alotis's 12½-inch f/7 reflector, dubbed Christine, has graceful styling that accents any setting, ranging from his living room to San Francisco's Golden Gate Bridge. Inlaid strips of walnut form a "ray trace" design on the sides of the fork. The telescope is seen here in its equatorial mode; when Alotis lifts up on the crosspiece at lower left the telescope turns into an altazimuth. He supplied all photographs for this article.

Once the glue had cured, the exterior was rounded with a small block plane and hand-sanded in steps to No. 400 abrasive. Bands of Honduran mahogany were cut, steamed, and bent around the ends of the tube. Then the center sec-

tion of each disk was punched out and the conduit removed. The outer ¾ inch of the disks remained in the tube as light baffles.

By now the finish was really beautiful. Many hardwoods acquire a polished but natural appearance when sanded with No. 400 or finer grit. I did not want the tube to look as if it were encased in plastic, but I knew it would have to be sealed. The whole affair was impregnated using epoxy resin of the WEST System ("wood epoxy saturation technique") developed for building wooden boats. The resin is a low-viscosity, low-surface-tension liquid with a remarkable ability to penetrate wood.

Resin applied inside the tube was drawn through the wood by capillary action. It appeared as glistening liquid beads after a journey of almost 3 inches through solid oak! Wood treated this way becomes stronger and harder and no longer absorbs water. I wrapped the tube's inside with fiberglass cloth and more epoxy.

Next a thin, slow-setting resin (but no cloth) was applied to the outside of the tube, forming a very hard and completely waterproof surface. A clear, marine-grade ultraviolet blocker was applied over the epoxy.

There are no metal fasteners anywhere in this telescope or in the mounting except for those that secure metal hardware. The wooden joints are doweled, splined or mortised, and then glued. If the ends were closed, Christine could probably go to sea!

DUAL-PURPOSE MOUNT

An altazimuth mount is compact and convenient because the eyepiece stays parallel to the ground. But an equatorial design would be easier to motorize for high-power views of the planets. I realized that I could have it both ways, with a *convertible mount!*

Essentially, an equatorial is like an altazimuth tilted over to suit the observer's latitude. But it takes an unusually strong altazimuth to survive, let alone function, off the vertical. So I decided on a fork mount that would use opposing, preloaded, tapered roller bearings. An automobile front-wheel hub and brake assembly were easily converted for the task. Having been forced unexpectedly to drive a car on two wheels some years ago, I was confident that the telescope was a small fraction of the load this hub could carry.

My hub assembly is mounted in a platform of oak and walnut 1¾ inches thick. The heavy planks were doweled together and wrapped in fiberglass cloth and epoxy. I then mortised the disk-brake rotor into this platform. It is bolted through with stainless-steel, socket-head cap screws and bedded in epoxy resin thickened with milled glass fibers.

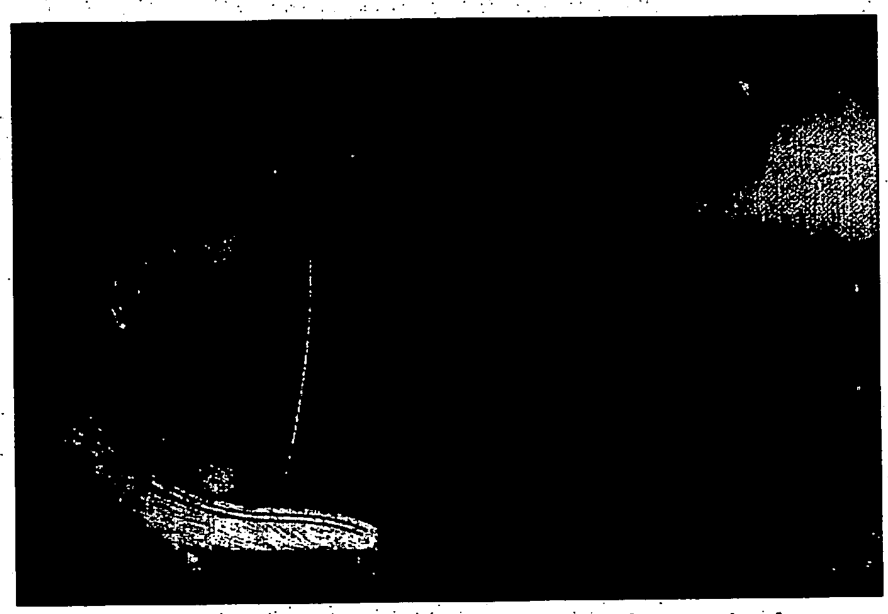
The rotor carries the hub casting. A ⅜-inch-thick steel disk was mounted on the other end of the spindle and mortised into the bottom of the fork, where it is bolted and glued in place the same way.

In altazimuth mode the platform stands on four casters made of stainless steel and urethane. Brakes on these casters lock the pivots as well as the wheels when I am observing. To operate in equatorial mode I tip the platform over so the instrument rests on extensions of the side panels. These pieces, cut from oak planks 12 inches wide and 1$\frac{1}{16}$ inches thick, extend well beyond the telescope's center of gravity; their ends are joined by a walnut plank for extra stability.

The fork is made of solid oak planks 1$\frac{1}{16}$ inches thick. Two such planks, glued and doweled together, form the bottom and each side. The two planking layers overlap at the corners, where they are cross-doweled and gusseted. The fork's inside surface has a fiberglass-cloth overlay. In my shop I placed the fork on one side and set a dial micrometer between the ends. Stacking 80 pounds on the other side closed the fork ends by only 0.02 inch — it's solid!

The declination bearings have caps made of oak, walnut, and brass. Bucking the trend of huge disks so common on big Dobsonians, Christine's side bearings are only 6⅜ inches in diameter. My idea was to minimize inherent drag and control the precise amount of friction with a brake. On each side two small Teflon buttons ¾ inch across and $\frac{3}{16}$ thick carry the load; they sit in ⅛-inch-deep "button holes" at the top of the fork.

The fork is removed by taking apart the automobile wheel assembly that defines the telescope's polar/azimuth axis. Note the small walnut block hinged to the platform's rear edge and lined with a Teflon strip. A brass thumbscrew and spring press this strip against the edge of the turntable, adjusting drag on the polar axis.



Here the telescope is seen in its altazimuth mode, where the crosspiece becomes a convenient handle for pushing the instrument along the ground on its casters.

To mount the diagonal mirror the author cut a strip of stainless steel to a bow-tie shape, 3 inches wide at the ends and narrowing to 2 inches in the center. The wide ends provide stability while the narrow waist reduces mass. Holes were punched for further reduction of top-end weight and thermal mass in the light path. Rolled to a radius of 6 inches, the curved supporting vane is both rigid and light. It is mounted from the inside, so no screws penetrate the main tube.

This mount has worked so well that only now, after four years, have I started to work on the drive. Guest observers are often surprised at the ease and smoothness of the telescope's motions. Either axis can be adjusted from almost no friction to as much drag as anyone would want. When the instrument is used in the equatorial mode, following Saturn at just over 500× is a thumb-and-forefinger task.

THE OPTICS

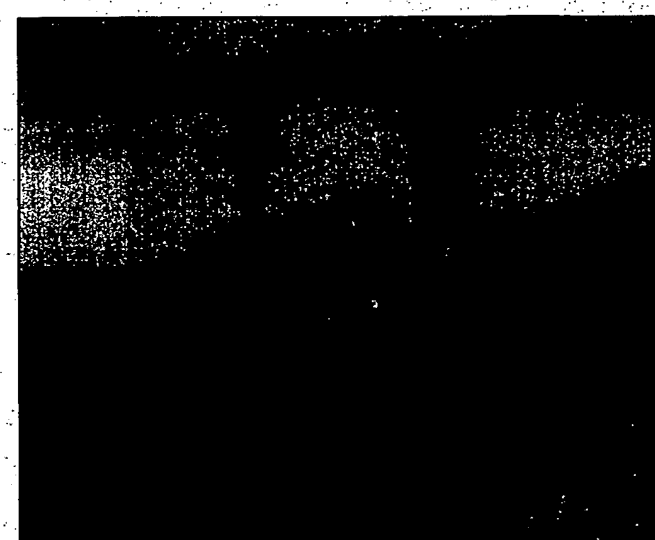
Paul Zurakowsky of the Chabot Observatory Telescope Makers Workshop has more than 25 years of experience with the Foucault test and its many variations. With his valuable advice, some guidance from Jean Texereau's *How To Make a Telescope* (Willmann-Bell, 1984), and a lot of perseverance, I managed to reduce the primary mirror's surface error to a calculated 1/32 wave.

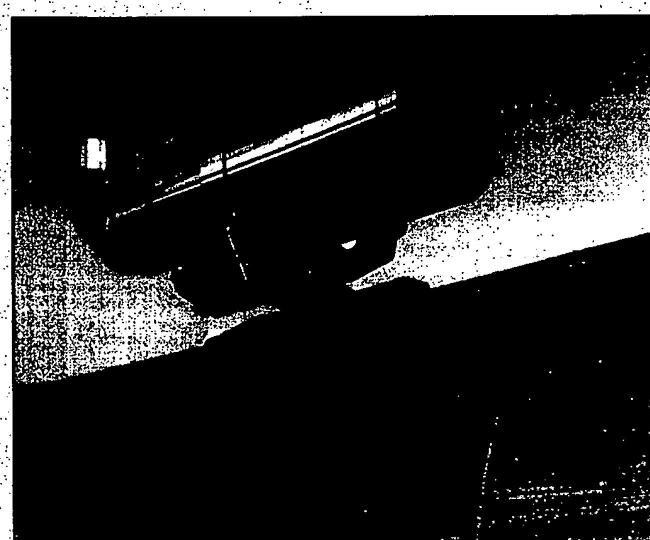
For the final test I took four sets of measurements on each of five zones, then rotated the mirror 90° and repeated the operation. The values in any one zone differed no more than 0.0005 inch, indicating the errors of measurement were small. My tester has a micrometer thimble reading to 0.0001 inch and uses a green light-emitting-diode (LED) source. Paul's readings were in good agreement with my own. Nevertheless, he points out that the Foucault test cannot be relied upon to measure surface errors smaller than about 1/20 wave, corresponding to 1/10 wave on the wavefront.

With coatings having 98 percent reflectivity on both mirrors, Christine delivers the same image brightness as a standard 14-inch Newtonian. The diagonal mirror has a 2.14-inch minor axis, obstructing 17 percent of the primary's diameter. At the focal plane a field 1 inch in diameter (2/3°) is uniformly illuminated.

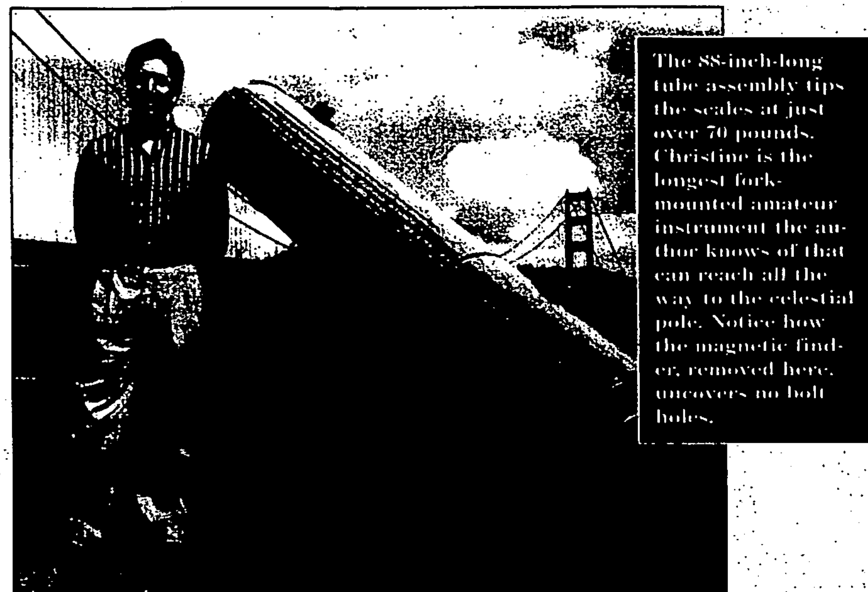
The primary-mirror cell is an integral part of the tube. Since an equatorial mounting subjects the mirror to various orientations, I could not employ a simple Dobsonian sling. Instead I drilled three 3/4-inch holes 1/2 inch deep into the tube from the inside and placed a small metal disk in each one. The rest of each hole is filled with RTV (room-temperature-vulcanizing) silicone. Behind each disk is a machine-thread insert, allowing socket-head screws to be inserted from the outside to apply gentle pressure against the circumference of the mirror.

For collimation, brass thumbscrews in the backplate push on three "pistons" of





Left: **The finder's cradle is made of maple, walnut, mahogany, and brass and has four adjusting screws that push against small copper pistons faced with felt pads.** ***Right:*** **To avoid drilling holes in the main tube Alotis decided to mount the finder magnetically. Three neodymium magnets, mortised into the inside of the tube, match up with three more in the finder base. Neodymium has the highest magnetic flux density of any permanent-magnet material. Each magnet is 1 inch in diameter and 1/8 inch thick. "If two of these magnets are ever allowed to touch each other," he says, "you'll need tools to separate them!"**



The 88-inch-long tube assembly tips the scales at just over 70 pounds. Christine is the longest fork-mounted amateur instrument the author knows of that can reach all the way to the celestial pole. Notice how the magnetic finder, removed here, uncovers no bolt holes.

birch plywood that bear directly against the back of the primary mirror. I suspect that this method may not offer enough support points for a very thin primary, but Christine's full-thickness Pyrex disk is, in the words of one observer, "some very happy glass."

FINDING THE "FAINT FUZZIES"

The maple sighting rail runs along the top of the tube. It does the job most folks do with a Telrad, except that no light is lost to reflection, it never fogs up, and there are no batteries or glaring red bull's-eyes. But, like the ubiquitous plastic box it replaces, this sighting rail works best for locating naked-eye objects. To pick up the faint fuzzies Christine needed help.

The finder was made from brass tubing and an f/3.75 objective 82 millimeters (3¼ inches) across. I threaded the inside of the tube and made a threaded PVC insert to serve as a lens cell. The first light baffle in the finder is at the point where the tube diameter changes to 2 inches, and the next is at the end of the 2-inch section. The 2-inch tube is internally threaded, and the whole interior is painted flat black.

A big Amici prism from a World War II Navy MK-47 gunsight has 1.32-inch faces, allowing me to use an eyepiece with a 1⁵⁄₁₆-inch field stop. The prism's bronze cell was fitted with a custom-made helical focuser and silver-brazed to the back of the finder. The combination provides upright, correct-reading views spanning 4° at 12× with no vignetting. The finder looks right at home on Christine and makes Messier hunting much easier.

The finder is mounted well down on the tube, close to the balance point, to reduce the need for counterweights. The low mounting point also lets me guide the scope while someone else is observing. This helps to get the most people to the eyepiece in a given amount of time at a star party.

Christine was a popular Merit Award winner at the 1992 Riverside Telescope Makers Conference. At the same meeting in 1994, where the finderscope and its magnetic mount received honorable mention, people waited a half hour in line for a view through Christine. One fellow (an optician) said, "It's been so long since I looked through a long-focus Newtonian that I forgot how nice it could be." Frequent comments like this validate at least some of the thinking behind the scope's unusual design.

It took more than a few hours to build Christine, but I don't feel a minute was wasted. She has redefined pride of ownership for me, and I've turned down offers for her running to five figures. (If someone were willing to wait three or four months for delivery, however, a sibling could be made to "look as if it belongs" in another home.) Just having a telescope like this in the house is tremendously satisfying. And, yes, Mary does lets me keep Christine in the living room.

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A member of the Fremont Peak Observatory Association, Group 70, and the Chabot Observatory Science Center, Alotis has years of professional experience in wood- and metalworking. He is a contractor in San Francisco.

58/9/7 (Item 3 from file: 6)
DIALOG(R)File 6:NTIS

1517424 NTIS Accession Number: AD-A222 245/3
Infrared Observations of the Solar System in Support of Large Aperture Infrared **Telescope** (LARITS): Calibration. Appendices
(Final technical rept. 1 Jul 85-28 Feb 89)
Shorthill, R. W.
Utah Univ., Salt Lake City. Dept. of Mechanical Engineering.
Corp. Source Codes: 016669008; 402440
Sponsor: Air Force Office of Scientific Research, Bolling AFB, DC.
Report No.: AFOSR-TR-90-0645-APP
1 Apr 90 165p
Languages: English
Journal Announcement: GRAI9019
Appendix to AD-A222 222.
Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)321-8547; and email at orders@ntis.fedworld.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
NTIS Prices: PC A08/MF A01
Country of Publication: United States
Contract No.: AFOSR-85-0181; 2311; A1
An infrared (I.R.) optics package designed for a I.R. detector calibration survey will be used in conjunction with the 90 inch **telescope** at the University of Wyoming, or as a portable, stand along unit. An important part of this instrument package is a **mechanical** light beam chopper which rotates with a fixed phase relation with respect to a wobbling secondary mirror in the **telescope**. A control circuit synchronizes the chopper to an external signal when used at the Wyoming site, or generates an internal reference frequency when used as a portable system. The portable system consists of a small **equatorial** **telescope** mount to support the same I.R. instrumentation package, which is used without additional optics. An automated positioning and **tracking** system encorporates a personal computer to control the environment of the **telescope** mount via stepper motors attached to the drive axis. The computer is also used to record all data on floppy disc for both fixed and portable systems. (RH)
Descriptors: *Infrared detectors; *Infrared **telescopes**; *Mirrors; * **Tracking** **telescopes**; *Infrared **tracking**; Stepper motors; Automatic **tracking**; Instrumentation; Portable equipment; Solar system ; Astronomical observatories; Calibration
Identifiers: **Equatorial** mounts; NTISDODXA; NTISDODAF
Section Headings: 54C (Astronomy and Astrophysics--Astrophysics); 84GE (Space Technology--General)

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Title: HOLDING STEADY.

Authors: Edberg, Steve

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Subject Terms: ASTRONOMICAL instruments
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Full Text Word Count: 1937

ISSN: 0091-6358

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Database: Business Source Corporate

HOLDING STEADY

A rock-stable telescope mount enables hours of successful stargazing.

Observing the stars with a rickety telescope mount is akin to watching TV with a flickering vertical hold: While you'll get the general idea of what's going on, chances are you'll stop watching long before the show is over. Likewise, mounts that sway and vibrate to the lightest touch or breeze send their images reeling about or out of the field of view. Enhance your viewing pleasure by using a steady mount with your telescope.

The advent of CCD cameras and guiders brings the problem of telescope stability to the forefront. Visual observers can make continual adjustments, and even photographers guiding long exposures often use less-than-perfect mounts. But the sensitivity of CCD imagers requires that stars in the field of view stay exactly in place. A floppy telescope mount just won't do.

Yet mounts are often an afterthought for both telescope users and manufacturers. A good rule of thumb for ultimate telescope stability mandates using an equatorial mount two sizes larger than the manufacturer's stated recommendations. Mounts are classified into two distinct groups: "alt-az" and equatorial. Alt-az mounts behave like a gun turret on a battleship or the head of a camera tripod. Both the turret and the tripod head elevate the cannon or camera to a desired altitude and can rotate to a desired azimuth around the horizon. Similarly, alt-az telescope mounts (one major style is the Dobsonian) permit users to aim their telescopes anywhere in the sky. Because of their size, stability is relatively easy to achieve.

During observing sessions, Earth's rotation shifts the field of view. An observer (or a computer) must constantly adjust the telescope's position in both altitude and azimuth. Because these change at different rates, tracking an object across the sky over the course of a night requires two motions. These motions also depend on the object's position in the sky relative to an observer's geographic position.

An equatorial mount simplifies this two-motion problem, but its complicated setup takes a bit of time. Whereas an alt-az mount is ready for use when placed anywhere with a clear view of the sky, a user must orient his or her equatorial mount properly. The principal axis, called the Right Ascension (R.A.) axis, should precisely parallel Earth's rotation axis. Once aligned, only one clock-driven motion is necessary to track objects across the sky. Another axis, the declination (Dec.) axis, runs perpendicular to the R.A. axis. These two axes allow the telescope to swivel to the desired orientation. With the clock motor on, the telescope follows the desired object as Earth rotates.

The most common equatorial mounts include the fork and the German equatorial varieties. A fork mount has one or two arms (tines) that orient the telescope parallel to the R.A. axis. German equatorial mounts appear ungainly because their axes and counterweights meet the telescope at a strange angle with respect to gravity -- making the whole setup look like a pair of

crossed Ts.

Some manufacturers cater to observers who want stable mounts with precision tracking capability. These advanced electronics aid viewing --so much so that they can be compared to the help provided by assistants to astronomers observing from large, professional observatories. Three models that stand out are discussed here.

Ease of Assembly

All the parts of the Astro-Physics 900 GTO mount slip together easily. This German equatorial mount features some interesting design and construction characteristics. The head (the support for the moving portions of the mount) is on a central pedestal -- or pier -- with legs at the bottom.

I was surprised at the ease of assembly. While that in itself doesn't ensure stability, hand-tightening the tension rods between the legs and top of the stand results in a surprisingly sturdy stand. I attached the equatorial head and its components with thumbscrews. The only time I needed tools (Allen wrenches) was to fasten the telescope mounting plate.

The next step is orienting and aligning the assembled mount so that the R.A. axis parallels Earth's axis. Here a user might be puzzled by the lack of apparent adjustments.

Contrary to popular opinion, a telescope mount does not need to be level, though that is helpful during critical alignment. The Astro-Physics mount cannot be conveniently leveled. Blocks set under the (non-adjustable) footpads make the pier vertical. In order to fine-tune the alignment, I looked through a hole in the R.A. shaft and used a hand screw to adjust altitude; azimuth is adjusted with opposing, pushing thumbscrews. Use the drift method for exact alignment. Watch stars as the telescope tracks and then adjust the pointing (in altitude and azimuth) of the R.A. axis to minimize -- and then zero-out -- the drift.

Follow the explicit instructions for setting up and using the mount. The power supply that turns the R.A. and Dec. axes uses 12 volts direct current (VDC). Believe it. The electronic hand control won't work properly using 12 VDC connected to a transformer plugged into a wall. Plan on using a 12-volt battery with the mount both at home and at remote observing sites.

The clock drive is so quiet that you might not think it's running unless you're looking through the eyepiece. As soon as power is applied, the mount tracks and can be pointed with its R.A. and Dec. motors. Again --follow those instructions. But the large, heavy hand control offers much more, including "Go To" capability once it has been initialized for the night. Be warned -- getting the "Go To" to work consistently requires some effort.

The 900 GTO mount is also designed to work with the Astro-Physics DigitalSky Voice software.

Large Diameter Legs

Celestron uses a different approach in building a sturdy telescope mount. Its CI-700 uses three long, large-diameter legs, sprouting from below the head. These come in a single assembly, though you must remove the plastic spreader from the threaded rod and reposition it during setup. A second spreader near the bottom of the legs remains slack even when the upper spreader is engaged tightly. Finally, a coupler that holds the electronics box is Allen-bolted to the top of the tripod and to the mount head.

Celestron suggests another tack for achieving polar alignment. (You might need to use blocks under the tripod legs.) Bolt the separate pole-finder telescope to the rear of the equatorial head. While you will probably have to roll the telescope mounting plate and telescope to one side to permit a clear field of view, you can now use the pole-finder, with its Polaris pointing reticle, for a quick, reasonably accurate polar alignment. Drift aligning (follow the supplied directions) is still necessary for the most demanding applications. And, since the pole-finder may arrive loose in its mount, drift aligning may also be necessary the first time it's used. Directions explain how to use the pole-finder. You will have to reverse these to align it initially. Adjust the azimuth and altitude using the Allen bolts.

The dual-T design limits the range of motion of all German equatorial mounts. Sooner or later, the mounting plate, counterweight, or telescope collides with the mount. The CI-700 is designed for use between latitudes from 13 degrees to 65 degrees north or south of the equator. Once the counterweight is added, that range is reduced to 20 degrees to 65 degrees.

Another limitation appears when observing the most important area of the sky -- along the meridian. The meridian is an imaginary circle that goes through the celestial poles and the observer's zenith -- the place in the sky where an object

reaches its maximum height during its nightly passage.

German equatorial mounts require a 180 degrees change in position in order to avoid a collision between moving and stationary parts. The CI-700 seems particularly limited in its freedom to cross the meridian before the 180 degrees flip. (A major advantage of fork mounts is that they permit tracking from horizon to horizon with no flip.)

With most alt-az mounts, only one axis requires balancing. Not so with equatorial mounts. With a German equatorial mount, the telescope and counterweight should balance each other (almost!) and the telescope front and rear should balance each other across the declination axis. Celestron gives clear instructions to guide the user through these necessary steps.

Rough-point the telescope. Release the double sets of inconveniently-located clutches on both axes so the telescope moves freely. Locate the object and tighten all four clutches. Make small corrections with slow motion controls near the R.A. and Dec. motors. Control fine adjustments by setting the electronics box to the desired motor speed.

Elaborate and Precise

Software Bisque ventured into hardware design and manufacture with its robotic Paramount GT-1100S German equatorial mount, designed for control via computer instructions. The GT-1100S is controlled by the user's computer at the telescope or via the Internet from anywhere. This offers great advantages as well as disadvantages.

Although the Paramount is designed for permanent installation, it can be transported. It's set to use in a latitude range of 18 degrees to 50 degrees without an optional extension.

Careful instructions guide the user through setup and balancing. Exact specifications -- including the number of full turns before the cables tear -- dictate cable length and placement not only between mount and computer, but also between camera and computer.

A suite of software applications must be installed and learned. Setting up the Paramount requires using the software to both map residual flexure in the mount (found in all mounts) and for polar alignment. When done thoroughly and carefully, the GT-1100S mount points anywhere in the sky with one arcminute accuracy (about 1/30 of the diameter of the moon).

The Paramount is designed for electronic imaging, including CCD and video. These imaging activities, along with the software that controls telescope motions, make the Paramount unique. Advanced observers will undoubtedly appreciate this elaborate and precise mount.

After-market telescope mounts offer wonderful observational opportunities. When shopping for a giant mount, consider ease of setup, purpose, and computer acumen. (You want to avoid relearning how to use the mount each time.)

Given the mounts now available, the observational rewards are a stable view and fine images -- and those are very sweet.

PARAMOUNT GT-1100S

Weight: 100 lbs. (45 kg). Includes: Robotic mount, joystick controller for local operation, two 20-lb. (9 kg) counterweights, and Software Bisque's Professional Astronomy Software Suite (PASS). Price: $8,500

Software Bisque, Inc. 912Twelfth Street Golden, CO 80401-1114 (800) 843-7599 (303) 278-4478 Fax: (303) 278-0045 http://www.bisque.com E-mail through website

CI-700 (ITEM #91525)

Includes: Tripod, equatorial head, electronics pier and counterweight. Weight: 114 lbs. (52 kg). Price: $3,390

Celestron International, Inc. 2835 Columbia Street Torrance, CA 90503 (800) 421-9649 (310) 328-9560 Fax: (310) 212-5835 http://www.celestron.com E-mail through website

ASTRO-PHYSICS 900 GTO

Weight: 100 lbs. (45 kg). Includes: Equatorial head and DigitalSkyVoice software. Price: $5,950

Astro-Physics, Inc. 11250 Forest Hills Road Rockford, IL 61115 (815) 282-1513 Fax: (815) 282-9847 http://www.Astro-Physics.com E-mail: info@astro-physics.com

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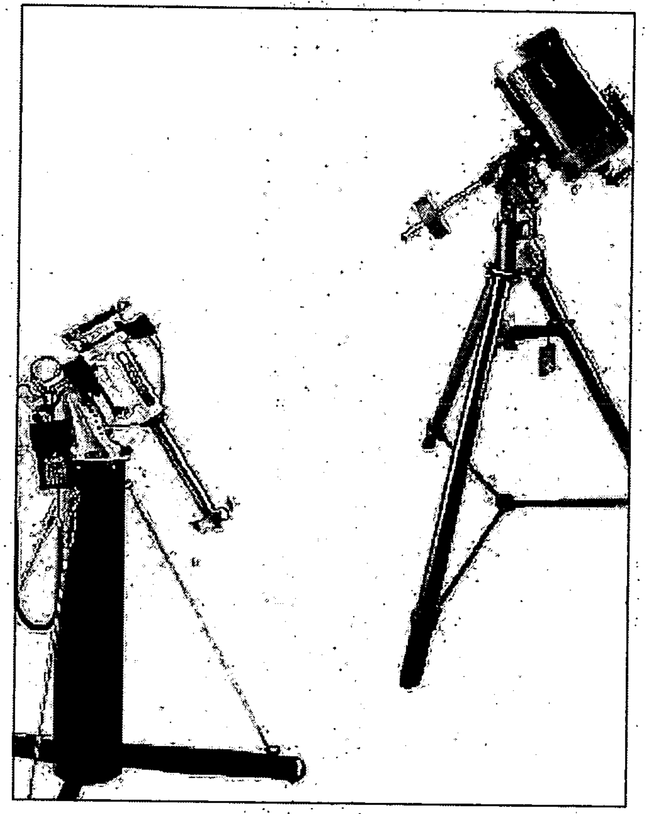
By Steve Edberg

For more than three decades, Steve Edberg has been using a surgeon's touch on floppy telescope mounts to make them work.

Source: Astronomy, May2001, Vol. 29 Issue 5, p78, 4p
Item: 4288241



Previous page: A solid central column on the Astro-Physics mount (left) ensures its sturdiness, while Celestron's heavy tripod (right) supports an equatorial head, electronics pier, and counterweight.
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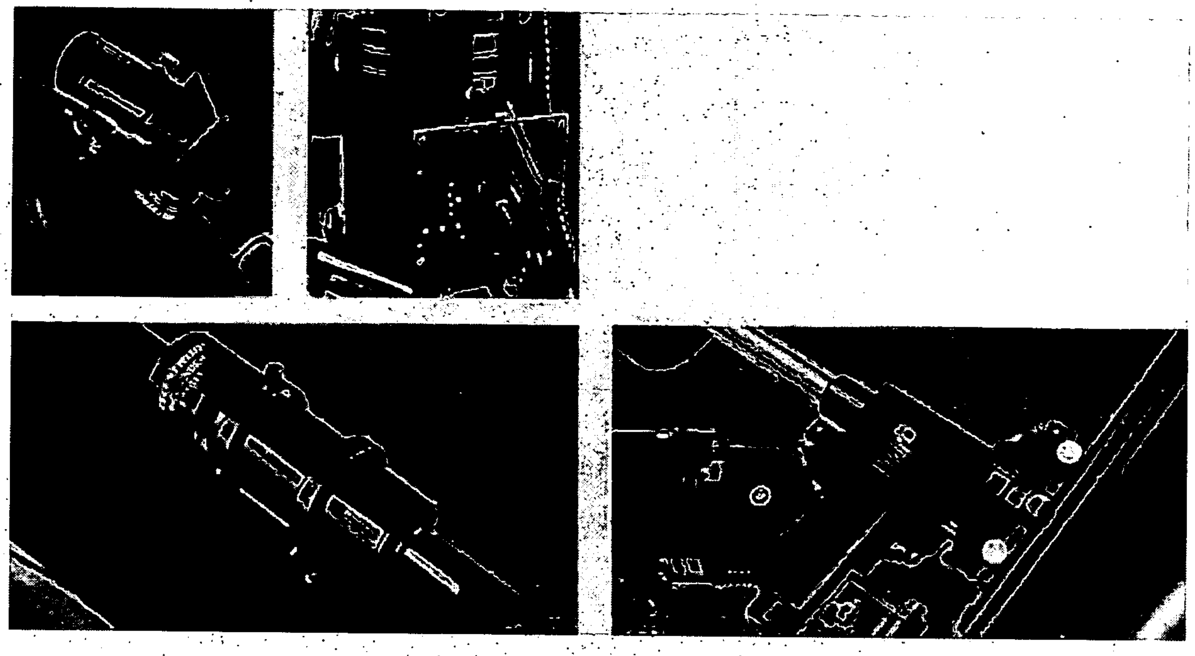


Left, clockwise from bottom: A Celestron finderscope helps point the way; the eyepiece comes into play after the CI-700 is set up for use; the CI-700's easy-to-install cables connect the electronics pier to the hand control and motor drive, which operates at varying speeds. Below: Three sets of gradations etched into the CI-700's equatorial head guide users.

36/9/4 (Item 1 from file: 6)
DIALOG(R)File 6:NTIS

0325552 NTIS Accession Number: AD-742 708/XAB
A Rotating **Bearing** Device
Amunov, A. G. ; Gasich, E. V. ; Zayats, A. L. ; Korobov, B. S. ; Dorfman, M. E.
Foreign Technology Div Wright-Patterson AFB Ohio
Corp. Source Codes: 141600
Report No.: FTD-HT-23-421-72
30 Mar 72 7p
Document Type: Patent; Translation
Journal Announcement: GRAI7214
Edited trans. of Patent (USSR) 271 952 2p 1970, by Bernard L. Tauber.
Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)321-8547; and email at orders@ntis.fedworld.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
NTIS Prices: PC A02/MF A01
Contract No.: AF-7343

The device is for improved precision in the running **track radius**. The assembly is based on an eccentrically mounted **platform interacting on a ball race with concave surfaces** corresponding with upper and lower **bearing** rings with clips also interacting with the convex surfaces of these rings. The **platform** is on rollers. The device consists of a revolv-**platform** and a mobile base on which are fixed brackets with eccentrics, the concave parts of the support rings are pressed flush by clips and bolts. (Author)

Descriptors: *Ball **bearings**; *Patents; Rotation; Radio **telescopes**; Interactions; Roll; Rings; Surfaces; Supports; USSR
Identifiers: Translations; NTISAF
Section Headings: 41J (Manufacturing Technology--Tooling, Machinery, and Tools)

L76 ANSWER 5 OF 54 AEROSPACE COPYRIGHT 2005 CSA on STN
AN 2002:039972 AEROSPACE
DN A99-22096
TI Tests of a precision tiltmeter system for measuring **telescope** position
AU Kibrick, Robert,; Robinson, Lloyd,; Wallace, Vernon,; Cowley, David, (Lick Observatory, Santa Cruz, CA)
SO IN:Telescope control systems III; Proceedings of the Conference, Kona, Hawaii, Mar. 20, 21, 1998 (A99-22060 05-62), Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 3351), 1998, p. 342-353, (1998) pp. 342-353. Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Vol. 3351). Refs: 8.Available from: Aeroplus Dispatch.
CY United States
DT Conference
LA English
AB We previously described a system that derives the pointing coordinates of an **equatorial telescope** by measuring the angular position of a dual-axis tilt-table whose frame is rigidly attached to the **telescope**'s primary mirror cell. Recent work has indicated the feasibility of several simplifications to that system. First, by use of suitable low friction **bearings** on the tilt-table axes, along with noncontacting encoders, the active servo loop is no longer needed to level the tilt-table. Rather, a simple suspended weight keeps the **platform** almost level, with the residual small tilt error measured by the precision tilt sensors. Second, by suitable orientation of the weight and the tilt sensors relative to the **telescope** polar axis, the system can measure **telescope** hour angle and declination directly, eliminating the need for the complex mathematical transform. Experimental results using these ideas are presented.
CC 37 Mechanical Engineering
CT *__TELESCOPES__; *TILTMETERS; *POSITION ERRORS; *PRIMARY MIRRORS; *ACTIVE CONTROL; *SERVOCONTROL; POSITION SENSING; PRECISION; AXES OF **ROTATION**; **BEARINGS**; FRICTION REDUCTION

Benefits of a split-dob mount
Moerke, David Edward
Sky and Telescope; Oct 1996; 92, 4; Research Library
pg. 75

Telescope Making

Edited by Roger W. Sinnott

Benefits of a Split-Dob Mount

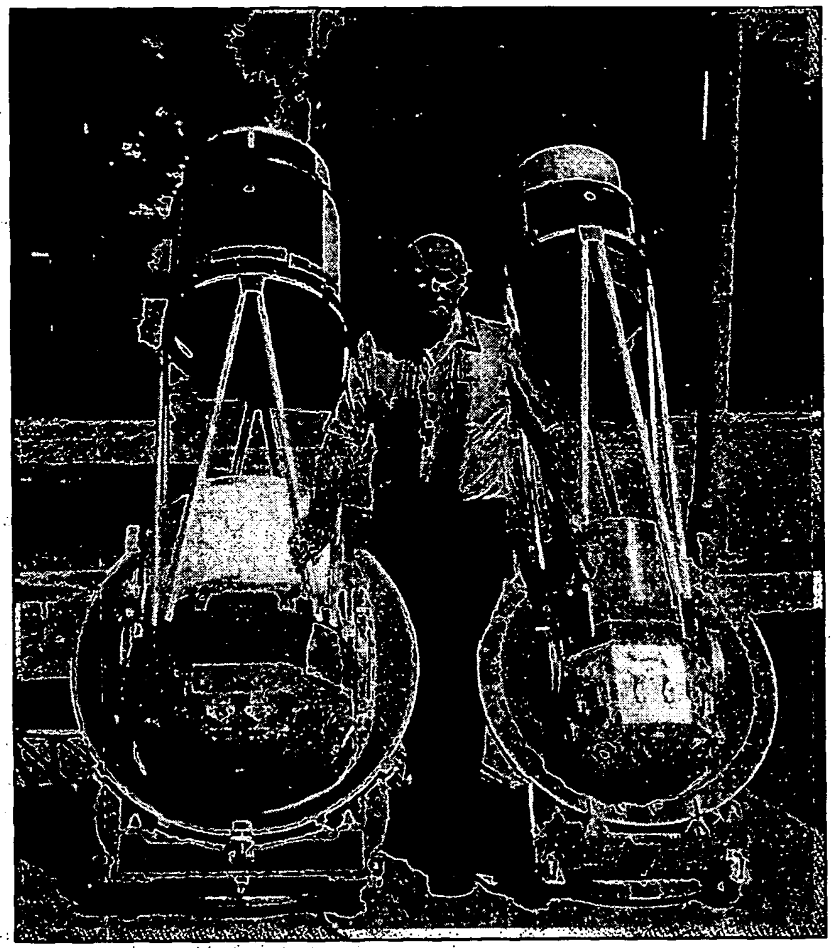
WOULDN'T IT BE NICE to have the tracking capability of an equatorial mount and the convenience of a Dobsonian, all in one package? Several years ago I built such mounts for my 12½- and 17½-inch reflectors, and last spring the concept really paid off. When Comet Hyakutake passed near the celestial pole, where equatorial motions are quite awkward, I simply switched to altazimuth mode!

While I came up with the split-Dob idea on my own, its prototype was, in fact, the Porter Garden Telescope advertised in **House Beautiful** *magazine during 1923 and 1924.*

Originally these telescopes had split-ring equatorial mounts, the design pioneered by Russell W. Porter and later modified for use on the 200-inch Palomar reflector. All I had to do was add a third axis — the azimuth base of a Dobsonian — to complete the transformation. The result is what I call a split-Dob mount.

I had already borrowed a Dobsonian idea for these mounts, using aluminum-rimmed wood disks riding on Teflon pads for the declination bearings. But even amazing Teflon has its limits. As the load increases the friction does too, and eventually the performance suffers. So for azimuth bearings on the base I used a strategy that some fellow telescope makers developed. The usual three outer pads of Teflon are employed, but part of the load they would normally carry is transferred to a central, slightly thicker Teflon pad. The load on this pad is quite severe, of course, but the leverage involved in turning the telescope overcomes this added friction easily. Meanwhile, the lightly loaded outer pads still provide smooth, stable motion.

Since the Dobsonian azimuth bearing was an afterthought, I retained the split-ring base as the primary support for ground contact. Whenever I want to switch to the Dob mode, I lock the split ring in place with the ring tips up (that is, the telescope is aimed along the meridian). For this purpose I use a central locking pin on the 17½-inch and two slide latches on the 12½. The declination axis, now horizontal, becomes the altitude axis.



California amateur David Moerke's 17½-inch f/4.5 and 12½-inch f/6 reflectors have mounts equipped with three axes rather than only two. As such, they offer the best of two worlds: equatorial tracking when needed, combined with the simplicity of a Dobsonian mount for sweeping in the polar regions or along the horizon. Except where noted, Moerke provided all photographs for this article.

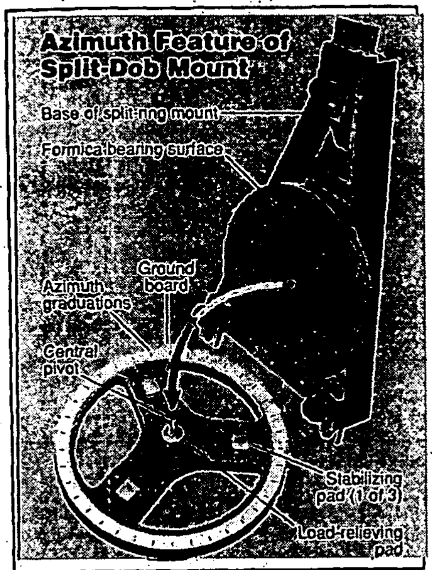
Next, with the aid of a small stand and lever, I lift the south end of the base slightly and insert small blocks under the edge of the circular Dob ground board at azimuth 120° (south-southeast) and 240° (south-southwest). Then I lift the opposite end, at its center, and place a third block at azimuth 0° (due north). The alignment pin between the base and ground board can be removed at this stage, releasing the instrument for motion in azimuth. The mount is now a Dobsonian, with no front board to restrict altitude travel.

To revert to the split-ring mode I simply reverse this 30-second process. Alternatively, if I want to slew equatorially while the instrument is sitting on the Dob blocks (which works fine), I just replace the alignment pin and unlock the

split ring. If I had planned these mounts as split Dobs from the start, I might have made a larger, square ground board as the primary ground contact, eliminating the need for blocks and making the changeover even quicker.

Plywood is the main construction material, except for the mirror cells and tube trusses. To encase the bottoms of the tubes I indulged in some needlessly fancy (but fun to make) aluminum covers.

The 17½-inch reflector has a 36¾-inch-diameter ring and all-up weight of about 220 pounds. Its primary mirror rides on an 18-point flotation cell. The 12½-inch, with 32-inch ring, is some 50 pounds lighter. Its mirror performs fine with a 9-point support. The diagonal cages on both instruments rotate, so I can always find a convenient orientation for the eyepiece while viewing any part of the sky.



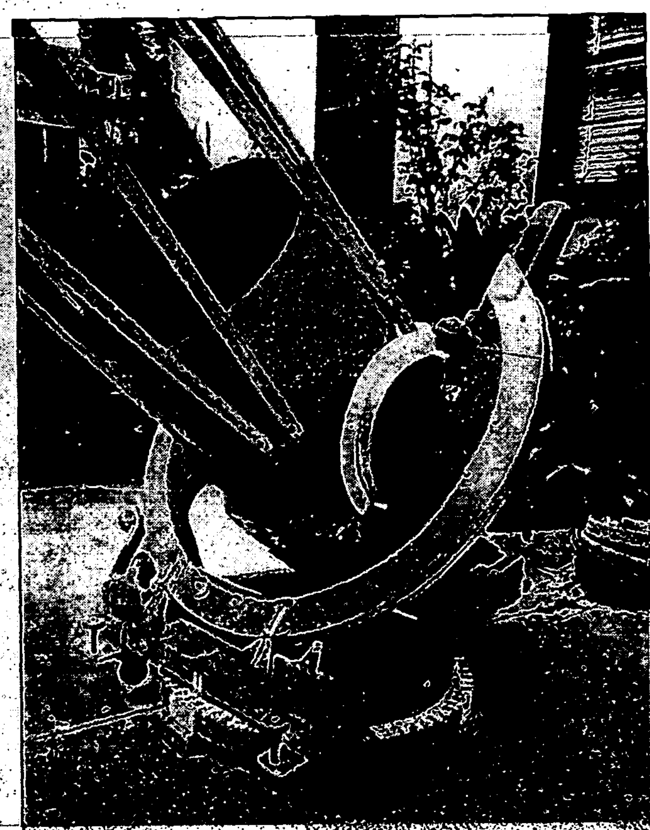
With the base of the split-ring mount lifted out of the way, details of the Dobsonian-style ground board are revealed.

ROOTS IN THE GARDEN TELESCOPE

While I came up with the split-Dob idea on my own, I have become aware that its prototype was, in fact, the Porter Garden Telescope of the early 1920s. Intrigued by Porter's creative concept and economy of design, I have tried to learn all I can about those fascinating instruments. My research has uncovered certain details that eluded even Berton C. Willard, author of *Russell W. Porter: Arctic Explorer, Artist, Telescope Maker* (available from Sky Publishing Corp.). A great read, this book was quite helpful in my quest.

In the January 1923 issue of *Scientific American*, a story titled "A Garden Telescope for the Amateur Astronomer" may be the first published description of Porter's invention. The instrument is described as "now being manufactured . . . to provide an entirely new and beautiful ornament which becomes a permanent fixture in the garden or on the lawn of its owner." The unsigned article goes on to explain that the instrument was a modified Newtonian reflector built of durable bronze. The 6-inch f/4 primary mirror "rests in a bowl of bronze lotus leaves from which rises a graceful blade or leaf carrying the prism at its farther end." Only the optics had to be brought indoors when not in use.

The garden telescope could even serve double duty as a sundial. The split-ring mount included setting circles and a slow-motion control in right ascension. Furthermore — and this is what is most relevant to the split-Dob concept — "the base supporting the bell has a horizontal circular track on which the mounting may be turned to any azimuth. This



These close-ups show the author's 12½-inch reflector ready for either altazimuth or equatorial operation. All the weight is supported by three wooden blocks under the calibrated ground board. *Left:* The south end of the mount has a polar bearing angled 34° upward from horizontal, corresponding to the latitude of Los Angeles. *Right:* In this view from northwest, note the two latches at the base of the split ring that secure it when, as here, the telescope is being used in the altazimuth mode.

Left: "What the phonograph and radio do for the ear, the Garden Telescope does for the eye," states a 15-page brochure, published in 1923 by the Jones & Lamson Machine Co. of Springfield, Vermont. "It is there, ever ready to entertain one's guests — whether it be the study of the heavens, or to see what Neighbor Jones is doing to his place across the valley." Containing this illustration, the rare pamphlet was recently acquired by Massachusetts amateur Kenneth Launie.

Right: Fewer than a dozen Porter garden telescopes survive today. This fine example, owned by Launie, is serial No. 46. *Sky & Telescope* photograph by Chuck Baker.

motion is found most convenient for terrestrial observation of objects near the horizon."

No. 53 is the highest surviving serial number, so at least that many garden telescopes were produced at the Jones & Lamson Machine Co. where Porter worked at the time. The total built is not known, as the records have been lost, but most estimates hover around 100. Another mystery is the production time frame. Some inkling can be gleaned from the fact that advertisements for garden telescopes ran in *House Beautiful* magazine from May 1923 through June 1924. Initially the instrument could be purchased for $250, the equivalent of about $2,300 today.

Exactly 10 years after the original article appeared, the January 1933 issue of *Scientific American* carried an ad that announced: "Now Available to the Public: The Porter Garden Telescope. . . . Made and Marketed by D. A. Patch, 38 Crescent Street, Springfield, Vermont." This was Donald Alden Patch, who had posed with a Springfield-type mount for some Porter sketches that were published in the March 1926 issue of *Scientific American* and in the first volume of Albert G. Ingalls's classic *Amateur Telescope Making* series, published the same year.

Although Patch continued to advertise telescope items and services through late 1938, I have found no further ads for the garden telescope. Perhaps his efforts to reintroduce it met with only limited success. Whatever the result, the fact that he tried to do so in the midst of the Great Depression is quite remarkable!

The split-Dob concept thus continues a time-honored tradition, and I have been very pleased at how my two-in-one mounts perform. They offer a nice alternative to the combination of a Dobsonian mount and equatorial tracking platform that other telescope makers have developed.

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Los Angeles, CA 90066

An aerospace sheet-metal mechanic by trade, David Moerke pursues astronomy, gardening, and geology in his spare time. He welcomes correspondence about the split-Dob concept.

Two affordable beginner's telescopes
Regen, David N
Sky and Telescope; Dec 1995; 90, 6; Research Library
pg. 47

S&T TEST REPORT

Edmund 3-inch f/6 Reflecting Telescope

Edmund Scientific Company
101 East Gloucester Pike
Barrington, NJ 08007

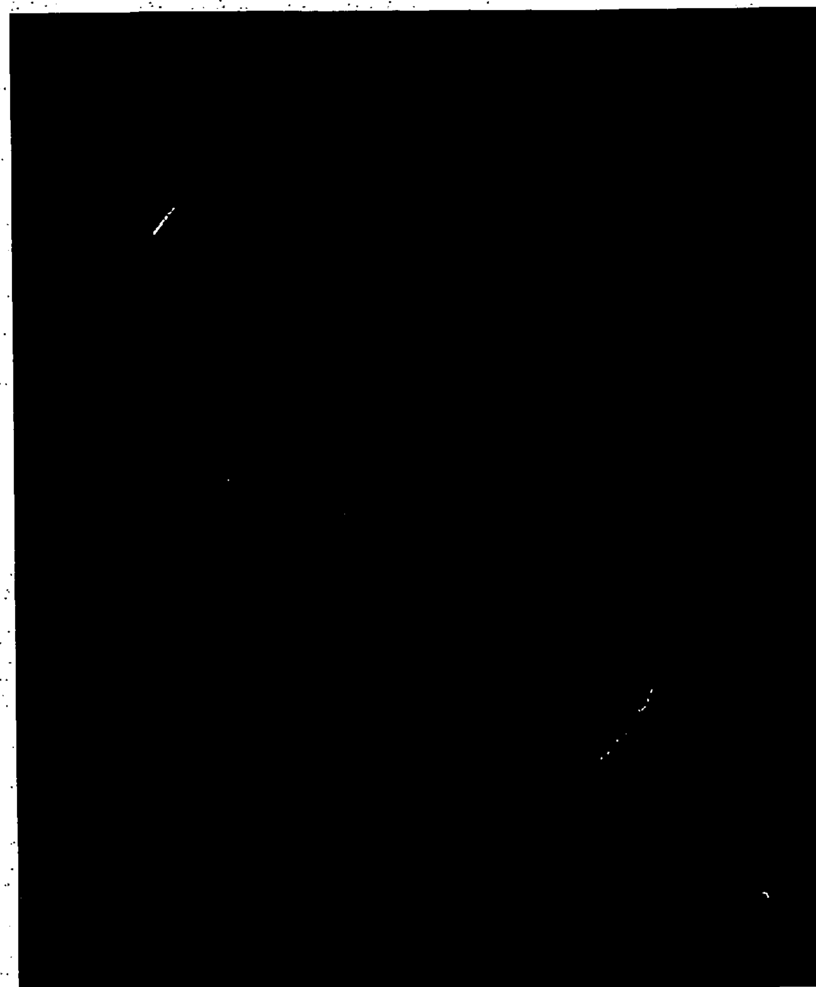
$229.00 including mount

Stargazer Sgr-3 Reflecting Telescope

Stargazer Steve

1752 Rutherglen Crescent
Sudbury, Ontario P3A 2K3
Canada

$209.00 including mount



Photos by CHUCK BAKER

Two Affordable Beginner's Telescopes

As AMATEUR ASTRONOMERS we are often asked, "What's a good beginner's telescope?" It's not easy to answer, but I sometimes say there are two basic kinds: telescopes to look through and telescopes to look at.

Sadly, most inexpensive telescopes are the latter kind. As holiday gift items they generate smiles that fade when the telescopes are first taken outside. Celestial objects prove difficult to find, and the mount shakes at the slightest touch. When something *finally* appears in the eyepiece it looks terrible at the 400× touted on the box.

Is the situation as gloomy as many of us think? Look at the wonderful things we can buy today for $250 or less; cameras, CD players, even TVs and VCRs. Are there astronomical telescopes in this price range that are easy to use and also provide a fine tour of the sky?

Objects were surprisingly bright and clear in these small-aperture scopes. The instruments are perfect for wide-field buffs.

A GOOD STARTER TELESCOPE

A worthwhile telescope encourages its owner to use it often. Here are some qualities that define an acceptable first instrument.

Good optics: The stars should look like pinpoints, not like blobs or sea gulls.

Small size and light weight: The scope should be easy to transport.

A steady, safe mounting: There's no point having good optics if the image dances around so much that you can't focus, or if the whole thing tips over at a nudge.

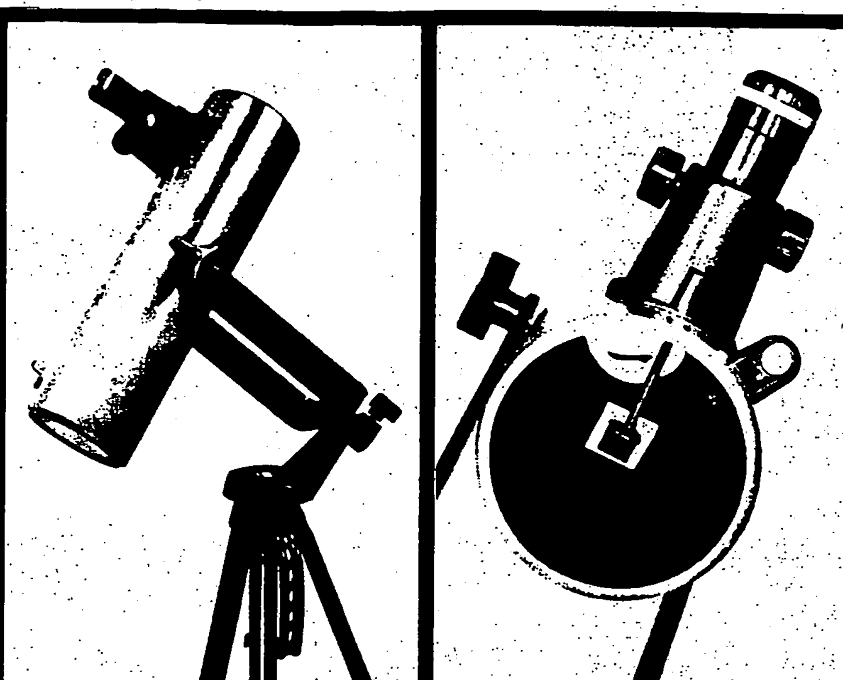
Ease of use: You don't need setting circles, slow-motion controls, or a clock drive to start learning about the sky.

Economy: The cost should be under $250 for a ready-to-use unit.

Is this asking a lot? You bet. Several promising 4-inch scopes, the often-recommended aperture, exceeded my $250 target. Two smaller contenders, both Newtonian reflectors, didn't. So Edmund Scientific's 3-inch and Stargazer Steve's Sgr-3 were obtained for review.

On paper these scopes share a number of practical advantages. Unlike those "to look at" scopes with their uncoated 0.965-inch eyepieces, both scopes come with a standard 1¼-inch focuser and a good eyepiece.

The primary mirrors are permanently mounted and collimated. This is fine for



Edmund Scientific
3-inch Newtonian Reflector

Primary: 3-inch (76-millimeter) diameter, Pyrex, paraboloized, thickness ratio 1:6

Focal length: 17.5 inches (444 mm), f/6

Secondary mirror: rectangular 1.062×1.5 inches (27×38 mm)

Mirror coatings: Protected aluminum

Optical mounting: Primary permanently mounted

Tube: ABS plastic, 15 inches (381 mm) long, 4 inches (102 mm) in diameter

Mount: Equatorial fork with tension adjustments, adjustable metal tripod

Eyepiece: 15-mm RKE (optimized Kellner), 30×, 1.6° field of view

Total weight: 12 lbs. (5.4 kilograms)

Edmund's 3-inch has a full-size focuser and finder sights mounted close to the tube. Its primary mirror is permanently collimated for easy maintenance.

small optics if it's solidly done. It certainly removes a major pitfall for the beginner. The makers of both scopes claim they yield diffraction-limited optical performance. Also, instead of a flimsy finder with plastic lenses, both scopes feature simple direct-sighting devices. Neither mount has slow motions, setting circles, or chrome. Basic scopes for basic views. How refreshing!

THE EDMUND SCIENTIFIC 3-INCH f/6 REFLECTOR

The Edmund scope came carefully packed. In addition to the instruction booklet, a planisphere and Edmund's "*Sky & Telescope* Astronomy Resource Guide" were included. The instructions are thorough and well written. Although a few practical matters like using red light to preserve night vision are missing, the observer who uses the planisphere and the instruction manual will have a head start for success. All beginner's scopes should be sent so well equipped!

Mechanics. Edmund's snappy-looking rig features a sturdy, red, ABS plastic tube with flat-black interior, bolted to a black aluminum fork. The tripod folds up to 24 inches and has a carry handle on the center post. Cam-type locks on the leg sections grip firmly, and the feet are equipped with metal spikes *and* retractable rubber tips. Packed in a padded bag, the whole scope fits in an airplane's overhead compartment.

Assembling the f/6 scope on its simple equatorial mount took less than a minute. The fork assembly's right-ascension shaft rides in a nylon sleeve that fits into a hole on the mounting head and locks with one knob. Nylon washers on the tube's mounting bolts provide a smooth friction surface when moving the scope in declination.

The focuser knob turns a rubber-sleeved shaft in contact with a metal drawtube that has nearly three inches of smooth travel. The drawtube is split and crimped to hold eyepieces snugly, but the fit is so tight that the black-anodized barrel of the Edmund 15-millimeter RKE eyepiece became scratched. Eyepieces with chromed barrels worked more smoothly.

Optics. The primary and secondary mirrors were clean, evenly coated, and solidly mounted. To provide a fully illuminated field to your eye, a Newtonian secondary mirror must intercept the cone of light from the primary and turn it 90°, filling the eyepiece's full field of view. Because Edmund's focuser is the standard height used on much larger telescopes, the distance from the secondary mirror to the eyepiece is a significant fraction of the total focal length. Thus the secondary has to be placed in a fairly fat part of the light cone, which requires it to be 35 percent of the primary's diameter.

This amount of central obstruction is large but not uncommon among fast telescopes. However, the Edmund secondary (on a single-stalk mount) is a 1.062-by-1.5-inch rectangle. Thus its square silhouette blocks more than 16 percent of the aperture's area, creating a potential for diminished contrast. I was anxious to see how such theoretical issues affected actual performance.

THE STARGAZER SGR-3

Stargazer comes with a short instructional videotape created for the absolute beginner. It isn't a slick production, but it does the job well and covers the introductory information one needs to start observing right away.

Both scopes have warnings about sensible Sun viewing located near the eyepiece. In fact the most dramatic part of the Stargazer tape is maker Stephen Dodson's demonstration of the danger of solar observing without a proper filter. He removes a filter from the front of the scope and places a thin strip of wood at the eyepiece, charring it black in seconds.

Mechanics. The Stargazer's optical tube is of sturdy composite material, painted flat black inside and textured to trap stray light. The friction eyepiece holder consists of a simple fixed tube mounted in a block of birch plywood. You focus by sliding the eyepiece up and down; this worked quite smoothly. The holder extends into the main tube and is trimmed away to form the secondary mirror mount.

This telescope has a handcrafted look and feel, revealing less concern with appearance than with utility and efficient construction. Its enamel-paint finish, unlike Edmund's, was obviously applied by hand. The vinyl covering on the tube is

just the ticket for dew-laden nights. Stargazer's vibration-damping wooden mounting cradle is reminiscent of the Dobsonian style. It fits over a wooden azimuth shaft on the tripod head. A wooden knob adjusts the tension on the altitude axis; the azimuth tension can be set using the square-tip screwdriver provided.

Dodson says the cradle sides are birch plywood, the bearing blocks and central azimuth shaft are maple, and the tripod legs are pine. He plans to offer an all-hardwood mount and tripod, clear finish, and choice of vinyl color.

Optics. The Stargazer is a 3-inch f/10 system, and both mirrors were clean and bright. The spherical primary is ½-inch-thick Pyrex. According to the maker, the aluminized optical surface has a multiple overcoat that gives 95 percent reflection. (Standard overcoated aluminum reflects less than 90 percent).

The long focal length and low-profile focuser (extending just two inches above the tube) allow the use of an elliptical secondary mirror with a minor axis of 0.83 inch (21 mm). The central obstruction is just 28 percent of the primary's diameter.

PERFORMANCE TESTING

Talk about simplicity! For the first evening of testing I simply walked out of my Manhattan apartment with a telescope in each hand.

Extending the first leg sections of the Edmund tripod put the eyepiece at a convenient height, though taller settings proved slightly unstable. The equatorial mount took a couple of minutes to set for my latitude. One tripod leg, pointed due south, can be raised or lowered to correctly aim the polar axis near Polaris. I found this was accurate enough to allow objects to be followed manually. Slewing with the Edmund telescope worked best with the tension knobs untightened; the friction was adequate to prevent slipping. The tripod head is plastic and has noticeable flexure, but overall the mount was effective.

The Stargazer was set up the second I spread its tripod legs. This tripod demonstrates how rigid yet lightweight a good design can be. The hardwood azimuth bearing turned smoothly, and the altitude motions were easy and positive. The mounting damped out vibration very well; after a light tap, the disturbance in the eyepiece died out in about two seconds. Vibrations took a little longer to subside in the metal-mounted Edmund scope, and a light breeze also seemed to affect it more.

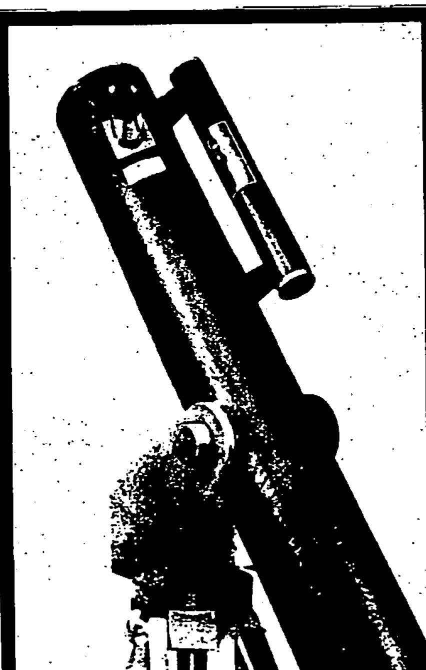
Edmund's 15-mm RKE (Rank Kellner Eyepiece) is nicer than most eyepieces supplied with a beginner's scope. Although it has short eye relief, the roughly 30× magnification gives a field of 1.6°, wide enough to see quite a bit of sky. The Stargazer's 18-mm Kellner is of good quality and provides a 1.25° true field in the f/10 system.

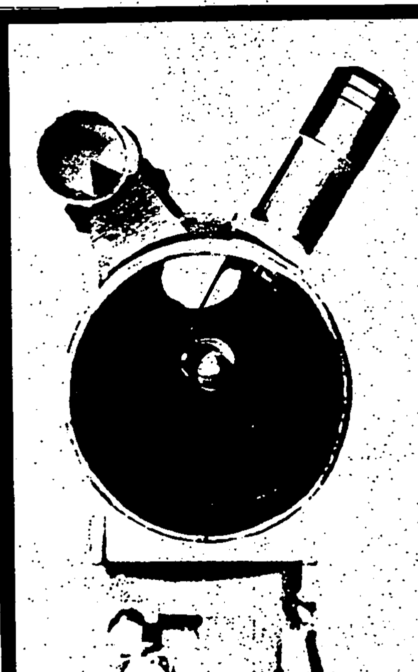
In addition to the eyepieces supplied, I used 26-mm and 13-mm Plössls and a 1.8× Barlow. The Moon, Spica, and Mars were within a few degrees of each other, providing a perfect target for low-power viewing. With the 26-mm eyepiece in both scopes, all three celestial objects fit inside the field of view. Similarly, both scopes revealed the Moon dazzlingly well. Crisp craters hugged the terminator and a few crater rims peeked out through the blackness of predawn, a sight to astonish any first-time observer.

With the RKE eyepiece Jupiter was so bright at 30× that it was difficult to make out any disk detail. My 13-mm Plössl provided a bit more contrast. The Galilean satellites were sharp, and I could see Io just barely separated from the planet's disk. The North and South Equatorial Belts displayed their brownish gray tones — not bad for 3-inch reflectors. Saturn's rings were nearly edge on yet I could see the thin line of the rings' shadow crossing the disk. With its f/10 optics and smaller secondary the Stargazer definitely had the upper hand. The sky around Jupiter was much darker, and more contrast was apparent in the belts on the disk.

Scanning the skies with these two scopes took a bit of practice. The Stargazer is almost twice as long as the Edmund but, with a hand at each end, is no more difficult to maneuver. Both friction eyepiece holders required some tugging to change eyepieces. It was nearly impossible to do this at high magnifications and still keep the scopes aimed.

Could these telescopes carry the beginner into the deep sky? To find out I took them to eastern Long Island, far





Stargazer Steve Sgr-3 Newtonian Reflector

Primary: 3-inch (76-mm) diameter, Pyrex, spherical, thickness ratio 1:6

Focal length: 30 inches (762 mm), f/10

Secondary mirror: elliptical, 0.83-inch (21-mm) minor axis

Mirror coatings: Aluminum with multilayer enhanced overcoating

Optical mounting: Primary permanently mounted

Tube: Fiber composition, 31 inches (787 mm) long, 4 inches (102 mm) in diameter

Mount: Wood altazimuth cradle, adjustable wood tripod

Eyepiece: 18-mm Kellner, 42×, 1.25° field of view

Total weight: 7 lbs. (3.2 kg)

A low-profile focuser allows the Stargazer to achieve full illumination with a minimal secondary mirror. The cantilevered tube cradle permits viewing almost to the zenith.

from city lights, on a crisp, clear August night. Under a 6th-magnitude sky I spent nearly an hour in the Sagittarius region, another hour in Cassiopeia, and the rest of the night on selected favorites.

The Lagoon Nebula, globular cluster M22, Double Cluster, open cluster M11, and Ring and Dumbbell planetary nebulae were easy to find. All were surprisingly bright and clear, given the small aperture of these scopes. In fact, these instruments are perfect for wide-field buffs like me. I don't want to look at magnificent objects in isolation; I want to see their neighborhoods too!

For this kind of observing, the Edmund with its shorter focal length had the edge. With my own 26-mm Plössl eyepiece delivering 17×, the Lagoon's image was quite bright, the scene being enhanced by a portion of the Sagittarius starcloud in the background. I found using the direct sighting devices difficult with both telescopes under these darker conditions and would recommend adding an illuminated reflex sight for serious deep-sky cruising.

The Edmund's relatively large secondary did rob the little scope of precious contrast. The background was gray, not black, even under this fairly dark sky. The deficiency was especially troublesome when viewing galaxies. For example, I assumed the wide field would allow me to see the entire Andromeda Galaxy, but the contrast was so low there wasn't much to look at except its core. The Stargazer, with a significantly darker background, allowed me to see much more detail.


The author photographed himself waiting for nightfall on eastern Long Island.

CONCLUSIONS

It is obvious that careful consideration has been given by both manufacturers to ensure a good first-telescope experience. I suggest the scopes might be equipped with low-power eyepieces, not the midrange ones now supplied. Objects would be much easier to find, the view would appear brighter, and it would have a touch more sparkle.

My personal philosophy regarding equipment for beginners is "less is more." Spend your time looking at the sky, not fumbling with complicated equipment. On several occasions I grabbed one of these scopes and headed outside for a quick view before turning in, leaving my sophisticated and expensive equipment inside.

Both of these small reflectors are fun and easy to use. No matter which one a beginner chooses, it won't be the manufacturer's fault if the owner doesn't get hooked on the sky. The novice who spends a year observing with either one will also be better prepared for future decisions about more expensive and temperamental instruments. I can recommend both the Edmund 3-inch and Stargazer Sgr-3.

DAVID N. REGEN
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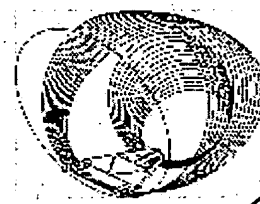
When he isn't photographing architecture or producing videos, David Regen spends spare time sharing the night sky with his neighbors.

— FYI —

Johnsonian Designs



2003

The COOL Technology behind the Johnsonian:

The design and development of the Johnsonian equatorial platform ...
No doubt that conventional techniques such as plywood and hardware store fittings can be fashioned

into things of beauty with lots of tender loving care. However, it is surprising that outside of the two largest commercial telescope manufacturer's, modern state of the art design, materials, and fabrication is seldom practiced. We all know that amateurs do the majority of innovation and creativity in our hobby....with successful concepts often cheapened into the mass market commercial

line-up. The Johnsonian is an attempt to innovate in a small business niche environment, using the finest materials, design tools, and manufacturing technologies available.

The Theoretical Development:
With an equatorial tracking platform, what is needed is to create a low profile table surface which is constrained to rotate about a virtual axis aligned to the pole. This was done quite successfully by ATM's Gee, Poncet, d'Autume, and others. The biggest obstacle faced is how to vary the virtual axis angle to accommodate the various latitude settings. This problem was never solved; thus, each platform had to be custom made for the specific latitude of use and scope size. Therefore, design and construction must be a handcrafted affair, limiting the market and providing expensive, long lead-times products. Solve this problem, and platforms can be mass produced and inventoried. The market potential expands, manufacturing costs drop, and the technology becomes mainstream.

Solving the latitude adjustment problem required the development of 3-dimensional contours which could change their bearing diameter as some function of latitude angle. Figure 1-4 show the concept development.... with the key development being the sweeping of many radii of figure 3 onto a small bearing segment (item 27). This is shown in Fig 4, and becomes the rear bearing block of the Johnsonian design...and is the basis for filed US and worldwide patent applications.

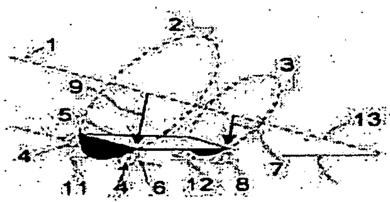


FIG. 1

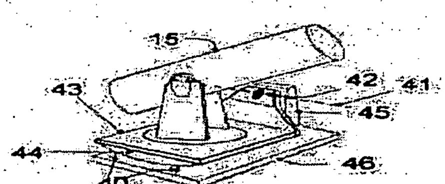


FIG. 2

These figures show a conventional fixed

virtual axis platform

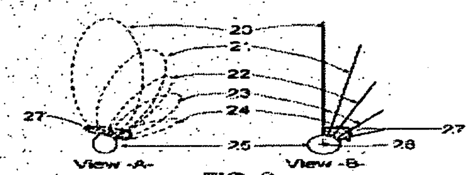


FIG. 3

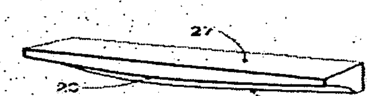


FIG. 4

Here is the solution for varying the rear bearing
diameter (item 3 of fig. 1). Now one platform can work at all latitudes with no adjustments

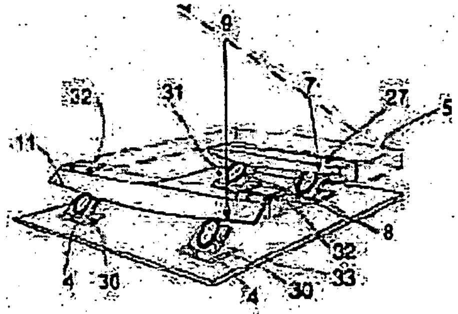


FIG. 5

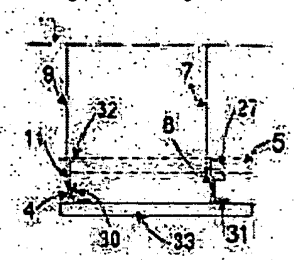


FIG. 6A

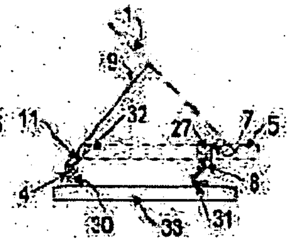


FIG. 6B

By setting just 3 angles, any latitude of operation can be selected. The Equator (0 deg) and Boise (44 deg N)

are shown. Note how the angle of polar axis (1) can be easily changed

Note that the front radius bearing is fixed.

Only it's angle needs to be adjusted.

Such a bearing surface must be extremely precise, mandating the use of precision machineable materials. 6061-T6 alloy aluminum was chosen to be run on a CNC 4 axis mill
to hold the necessary tolerances.... less than +/-0.0005" in over the entire surface.

Design Objectives:

Mass produce the Johnsonian for lowest cost next-day deliveries
Maintain observatory accuracies for performance and quality
Impervious to moisture or environment
Rock solid rigidity and load handling
Very Low profile
Based on the variety of scope sizes and features needed, one design would not work. Therefore, 3 versions of the design concept were created to address the needs of most users... to be fabricated in one of two non-corrosive metals. Coated or painted metals and wood products were not considered (such as painted steel which is cheaper) due to certain degrading with time and use.

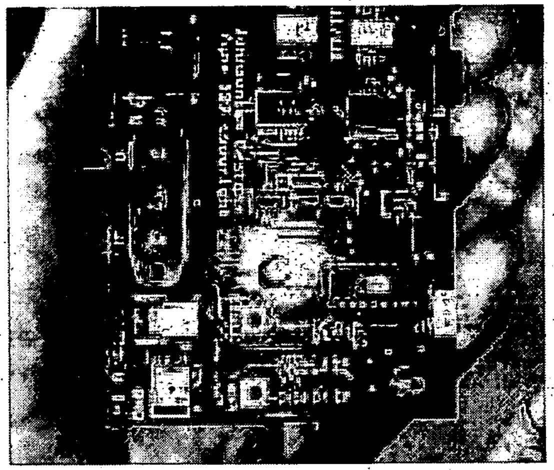
Materials Engineering:

Of the three highest performing materials best suited to telescope applications, heat treated alloy aluminum and stainless steels were chosen. Carbon graphite composites were considered, but rejected when cost and fabrication difficulties were analyzed. The important physical properties needed for this application are stiffness (Young's modulus,
expressed as E in psi or GPa) and yield strength (in thousands of psi, or Kpsi) . For a given sectional area, the stiffness of the steels, both carbon and stainless, is 3X that of aluminum (30x106 psi, vs. 10x106). However, even aluminum is 6X the stiffness of premium slow grown birch plywood. By casting in integral rib structures, the effective stiffness is increased another 10-20 times. An equally important parameter is yield strength. By operating a materials at increasing levels of stress without deformation or failure, very compact structures result. Thus, even 6061-T6 aluminum at 37Kpsi yield strength is stronger than typical low carbon steels(26-32KPSI). Stainless steels, particularly 1/2 hard and above, have yield strengths between 100-200Kpsi. This explains the weight capacity differences between the TypeV and Type IV. For the precision machined bearings, 6061-T6 aluminum was chosen for it's excellent machinability and stability in high precision applications. Even when wet, the coefficient of friction between the metal surfaces exceeds 0.6, which will drive even the most unbalanced Dobsonian.

Manufacturing technology

Fabrication of all Johnsonian's is carried in colorado at aluminum foundries, CNC machine
shops, and at our headquarters in Loveland. 4 axis CNC milling and CNC turning assure consistency far above traditional woodworking operations. .

Electronics



All Johnsonian's come with a 20 Mhz Quartz reference controller as standard. This ensures absolute frequency stability despite changes in temperature and voltage. The speed can be changed from board located buttons or the hand-controller, and uses 16 bit words to provide very fine speed increments. Advanced pulse width modulation control and Microstepping of each stepper reduces the current drain to the batteries, thus doubling or tripling the battery life over traditional stepper IC's. Use of a socketed PIC micro controller allows for software upgrades by simply swapping the chip. The hand controller integrates a super bright red LED for chart reading or finding things in the dark, and has an 4X fast slew mode in RA. The hand controller jack is compatible with ST-4 type autoguiders. This feature requires

an upgrade processor available soon. Northern and Southern

hemisphere operations are supported

Home | Type V | Type IV | GOTO | Order | Contact | Info

Johnsonian Designs
3466 E. County Rd 20-C
Unit B-20
Loveland, Colorado 80537
Shop Phone 970-613-0788
e-mail sam@johnsonian.com

A "hot" telescope gets even hotter
Dennis di Cicco
Sky and Telescope; May 1999; 97, 5; Research Library
pg. 61

A "Hot" Telescope Gets Even Hotter

"Oh joy, rapture! I've got a brain."
— (Scarecrow in the movie *The Wizard of Oz*)

Meade sets a new standard by providing user-friendly capabilities never before available from an inexpensive telescope. | **By Dennis di Cicco**

When we reviewed Meade's 90-millimeter ETX Maksutov-Cassegrain in the January 1997 issue, we called it the hottest telescope ever. Well, it just got hotter. A *lot* hotter!

Meade has introduced its new ETX-90/EC, with the EC designating electronic control. (By the way, the ET in ETX is from Meade's founder, John Diebel, who envisioned *E*veryone's *T*elescope.) Retailing for the same $595 price as its predecessor, the ETX-90/EC has built-in motor drives and a push-button hand controller.

As welcome as these features are, the real excitement surrounds the optional Autostar controller. For $149 you can skip a trip to Oz and buy the ETX-90/EC a brain. And what a brain it is! Foremost among Autostar's features is the ability to automatically point the scope to more than 12,000 targets stored in an internal database. But it does much more than that. In fact, the Autostar-equipped ETX-90/EC can do things no commercial telescope has ever done before.

Within days of the ETX-90/EC's unveiling last January, *Sky & Telescope* obtained the first unit Meade loaned for review. While the scope was a production unit (manufacturing had been under way for several months in anticipation of initial demand), the Autostar was still being tweaked (I tested version 1.0c).

Meade's New ETX-90/EC

ETX-90/EC
90-mm Maksutov-Cassegrain with motor drives and optional computer controller

Meade Instruments Corporation
(sold through dealers)
www.meade.com

Price:
$595 basic telescope
$149 Autostar controller
$199.95 Field tripod

Outwardly similar to its predecessor, Meade's new ETX-90/EC 3½-inch Maksutov-Cassegrain now has motor drives on both axes and a push-button hand controller (an optional computerized controller is available). The optical tube is identical to that of the original ETX, including the same fine optics and a threaded aluminum lens cap. All *Sky & Telescope* photographs are by Chuck Baker.

The most exciting aspect of the new scope is the optional Autostar hand controller — the "brains" of the system. Among its scores of features is the ability to automatically slew the telescope to more than 12,000 celestial targets. Autostar is smaller, lighter, and more ergonomically friendly than the bulky hand controller for Meade's line of LX200 telescopes. All of Autostar's data and functions can be accessed by using just the Mode, Enter, and scrolling keys. All keys are backlit (right).

The Optics

The ETX-90/EC has a 90-mm (3½-inch) clear aperture and a focal length of 1,250 mm, yielding f/13.8. It is the same optical tube assembly as the original ETX. Will old ETXs fit on the new EC mount? Yes. Will Meade sell the new mount separately? As of press time the question remained open.

The optics in our test telescope were excellent and consistent with the scope we reviewed in 1997, which was anonymously purchased. Star images came to a precise focus with a crisp, round Airy disk surrounded by a bright diffraction ring and several fainter ones. Star images inside and outside of focus were indistinguishable from one another. The optics are fully baffled to suppress flare and scattered light, and multicoatings provide very contrasty views of the Moon and terrestrial scenes.

At 156× the scope easily showed the companion of the brilliant double star Rigel in Orion. Although the 9½-arcsecond separation of this pair isn't challenging for small apertures, the nearly 7-magnitude difference in brightness between the two stars can overwhelm optics that deliver low-contrast images. At the same magnification the ETX-90/EC split 4-arcsecond Castor in Gemini with lots of dark sky between the components. What really impressed me, however, was the clean split of Eta Orionis at 250×. With a current separation of 1.7 arcseconds, this pair is within 0.5 arcsecond of the scope's Dawes limit. The companion was readily apparent within the first diffraction ring of the primary, and a thread of dark sky divided the stars during moments of good seeing.

Familiar with how rarely 8-inch and larger telescopes experience moments of good seeing, I was pleasantly surprised by how often the atmosphere served up diffraction-limited conditions for the small-aperture ETX-90/EC. You don't see more detail with the small scope, but the sharp images are very satisfying and a frequent reminder of the excellent optical quality.

The Moon was beautiful at any magnification, with black shadows contrasting sharply with illuminated features along the terminator. Venus appeared dazzlingly white with no color fringes except those caused by atmospheric refraction. Like Venus, Jupiter was low in the January evening sky, but several bands were easily seen on the planet's disk.

Saturn was very impressive. As the planet snapped into focus in the supplied 26-mm (48×) eyepiece, I could easily see the rings' Cassini Division and several bands on the ball of the planet. Even at this modest magnification the moons Titan, Rhea, and Dione were clearly visible, and Tethys became evident when the power was increased to 156×.

The bottom line is that the ETX-90/EC showed me everything I could expect from an instrument of its size. The mechanics of the optical tube assembly are also first rate, with barely a hint of lateral image shift as the focus knob is turned back and forth.

The Mount

Although outwardly similar to the original ETX, the new mount is functionally very different. The manual slow-motion controls are replaced with small DC motors driving metal worm gears through plastic gear trains. Power comes from eight AA batteries in the base, and there is provision for an external 12-volt source (though none is supplied with the scope).

Internal power comes from eight AA batteries located under a snap-on cover at the bottom of the scope's base. The holder clearly shows the correct polarity for each battery. The scope can also be powered by an optional 12-volt external source.

Even discount alkaline batteries provided more than 20 hours of operation with heavy slewing. As the batteries near exhaustion, slewing becomes sluggish. With the optional Autostar attached, erratic operation is a sure sign that the batteries need replacing.

The mount has internal stops that limit rotation in altitude (or declination, if used equatorially) to about 125° and in azimuth (right ascension) to slightly less than two full turns. The clamp for the azimuth axis is a large lever, and the altitude clamp is controlled by a fluted knob on one fork arm; a user can operate both easily while wearing heavy gloves. The standard controller with the ETX-90/EC is designed for comfortable one-hand operation. Either this controller or the optional Autostar must be connected to the scope for the motors to operate. The standard controller offers four slewing speeds: 5°, 0.75°, 8 arcminutes, and 2 arcminutes per second.

The ETX-90/EC can be set to power up in either altazimuth or equatorial mode. In the former the motors run only when the slewing keys are pressed; in the latter the right-ascension drive operates at sidereal rate and requires polar alignment. At first I considered the factory default of altazimuth rather strange for an astronomical telescope, but I'll bet most people will start out using the scope this way. In addition to checking out a bird feeder and other daytime sights, altazimuth operation is convenient for viewing celestial objects, since the telescope functions like a Dobsonian with electric controls! This bypasses the need for a tripod and the hassles of polar aligning the scope.

The tabletop tripod legs are no longer standard equipment. While this certainly helps keep the cost of the basic telescope down, it's also indicative of how most people will use this instrument, especially with the Autostar option. Meade sells a field tripod ($199.95) for the ETX-90/EC that is well suited to altazimuth and equatorial use. Another possibility for the altazimuth configuration is a simple pier, such as an attractive one available in garden shops for birdbaths or sundials. Piers offer easy access to the telescope regardless of where it's aimed. Another reason for using the altazimuth mode is that it offers full sky coverage. At any latitude lower than about 45°, a polar-aligned ETX-90/EC cannot view objects near the southern horizon because the optical tube hits the base of the mount.

Legs for the tabletop tripod are now an optional purchase ($29.95). But, as mentioned in the text, people are likely to use the telescope in other mounting configurations.

When the scope is polar aligned the tracking rate is very good, easily holding objects in the 48× eyepiece for more than an hour. The mount and motors are robust enough to support a 35-mm or small CCD camera for snapshots, but the drive is not designed for long-exposure astro imaging. After slewing eastward, especially at the faster speeds, the scope pauses as backlash works its way out of the gear train before it resumes celestial tracking. Sometimes it took 15 seconds or more for the scope to begin moving, and twice as much time could pass before the full tracking rate resumed. Nevertheless, it's easy to eliminate this lag by tapping the west push button for a second or two to speed up the backlash removal.

The Autostar

Advertisements merely hint at the range of Autostar functions; even in this review I don't have room to list them all, let alone describe them in detail. The more time I spent with Autostar, the more I became amazed at what is packed into this relatively small controller. Here are some examples.

While reading Autostar's two-line, liquid-crystal display (LCD) my first evening out with the scope, I decided to explore the Event menu. Here a keypress or two gives the times of sunrise, sunset, moonrise, and moonset (accurate to a few minutes for the Sun and about 10 or so for the Moon) as well as the dates and times of upcoming principal Moon phases. Also available are dates of meteor showers, solstices, equinoxes, solar and

A flip mirror, operated by the arrowed knob, directs light from the straight-through port for a camera to the 1¼-inch eyepiece position. The drive is not designed for long-exposure astro imaging, but snapshots of terrestrial scenes and bright astronomical targets are possible.

The standard 8×21, erect-image finder has good optics but is very difficult to look through in some orientations of the scope. Many people may prefer an optional 8×24 right-angle finder ($49.95) available from Meade.

lunar eclipses, and the "Min. of Algol."

Assuming that this last item might be a mystery to beginners, I pressed the Enter key to learn more and was informed that, whatever "Min. of Algol" was, it was going to happen in a few hours. I pressed the Go To key and the scope's motors whirred into action (when slewing at high speed they sound like one of today's ubiquitous remote-controlled toy cars) as the scope headed to a point high overhead. It stopped with a nondescript white star in the eyepiece, and I could imagine someone new to astronomy thinking, "So what?" The answer came with additional keypresses. Algol, I learned from reading the LCD, is Beta Persei. Also displayed were its celestial coordinates, magnitude, spectral classification, and information about it being a multiple star located 72.4 light-years from the Sun. A final keypress launched a 300-plus-word description of this eclipsing variable star scrolling across the LCD. That's roughly equivalent to a half column of text on this page. Suddenly Algol (and its upcoming minimum light during eclipse) became a lot more interesting!

Some of the information on Algol would be cryptic to a beginner (some abbreviations left even me wondering). But several terms in the description — "light-year," for example — appear within brackets, and a keypress shoots you to a definition. This is the first telescope that can give you a course in astronomy — impressive stuff.

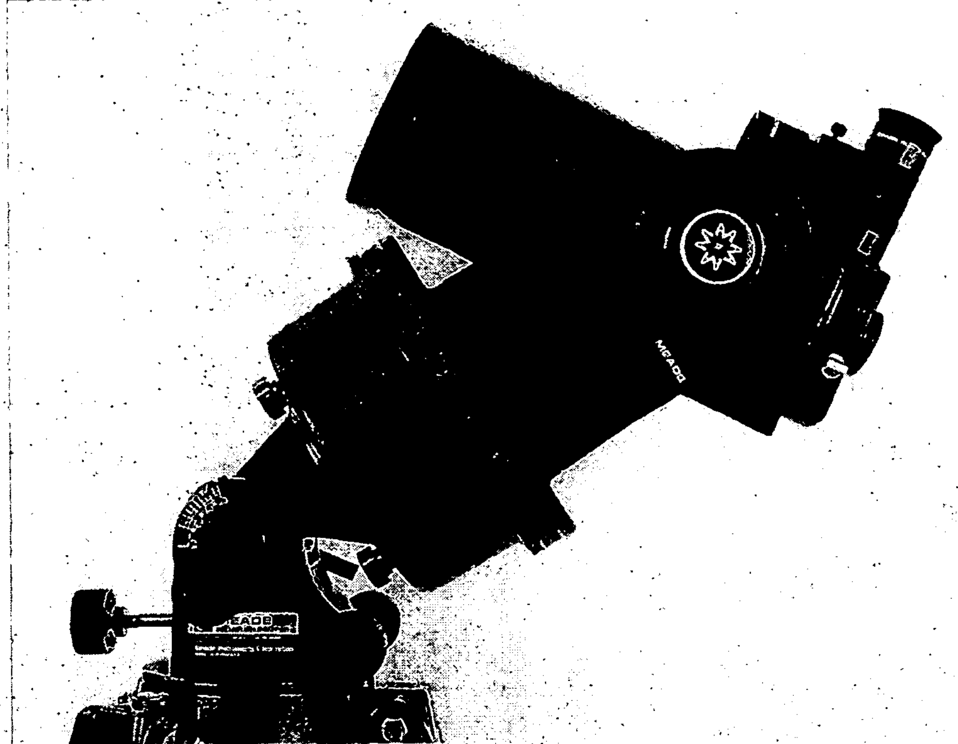
With upward of a megabyte of compressed text stored in Autostar, there are bound to be some mistakes, but they should be fixed quickly. What makes the unit attractive from this standpoint is that it is engineered with software revisions in mind. An optional cable connects it to an IBM-compatible computer so that the software can be updated with files downloaded from Meade's Web site (www.meade.com).

Most field tests were done with the telescope in altazimuth mode using the optional field tripod. This arrangement allowed full access to the sky, but it was difficult to reach the focus knob when the scope was pointed to high altitudes. An optional electric focuser is available.

It can even be linked to another Autostar to transfer files between units, including catalogs of user-entered targets.

With Autostar able to do so much, the question arises as to how easy it is to operate. I learned the answer in an unexpected way.

I assumed my experience with Meade's computerized LX200 telescopes would breeze me through Autostar's basics. Wrong! As the Sun set on that first clear evening, I plugged Autostar into the scope and was confronted with a very unfamiliar initializing procedure. There's no need to explain the steps here, since the manual walks you through them with clear instructions. Furthermore, you can do them anytime — they don't require viewing the sky. I recommend you spend 30 to 45 minutes indoors with the Autostar the first time you turn it on. This will give you plenty of time to enter data (some of which needs doing only once), make and correct mistakes, calibrate the motors, and, most important, learn to navigate Autostar's menus. Skip entering your observing site's precise coordinates (if you know them), since the proper format isn't obvious on the LCD. Instead, select a nearby geographical location from the huge database in Autostar's memory. The format of these data will guide you when you input your own values later. The unit can be set up for multiple sites, each of which can be selected at the touch of a key.



The polar-aligned mode is the only arrangement that allows automatic tracking of celestial objects with the standard hand controller. At latitudes below about 60°, the base of the polar-aligned mount blocks the scope from pointing at the southern horizon.

After this initial setup, I mounted the scope in altazimuth mode on the field tripod resting on my gently sloping driveway. Because Autostar has no internal battery for its clock, you must input the date and time whenever you power up the telescope. The default values are the last date the scope was used and 8:00 p.m., so a few keypresses will typically be all that's necessary. As an indication of how well Autostar is engineered, when the display requests the date and time, a map light automatically turns on so you can read your watch!

I selected the "easy" alignment procedure and followed the instructions that scrolled across the LCD — no need to fumble with the manual in the dark. First I leveled the telescope's tube and pointed it north by eyeballing the North Star, which was just emerging out of the twilight. This done, I hit the Enter key and was instructed to center Capella in the finder. Before I could glance up to see if this star was visible, the scope automatically began slewing and stopped with Capella well within the field of the finder. I was astounded! Clearly the accuracy of this maneuver hinges on how well the scope was initially leveled and aimed northward, and my estimates were rough. Using Autostar's slewing keys I nudged Capella to the center of the cross hairs and hit the Enter key.

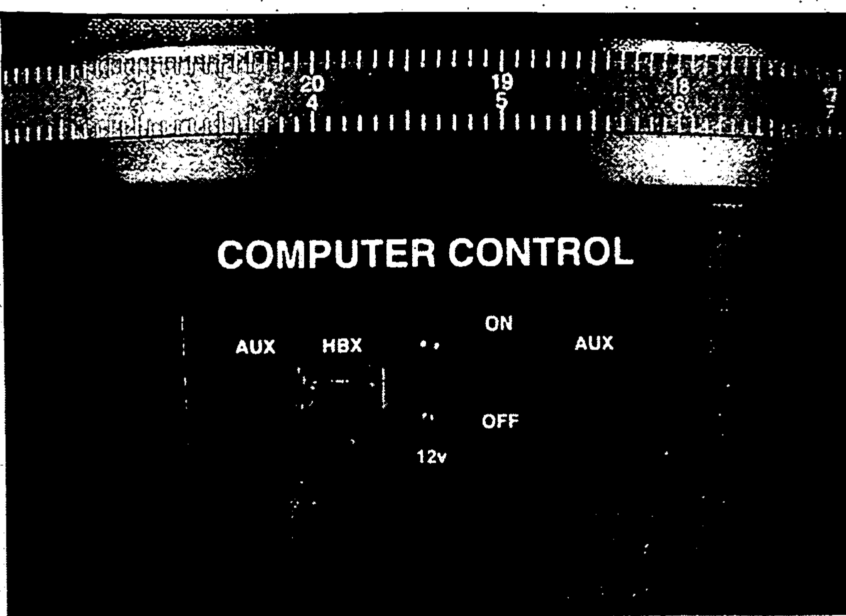
Now I was told to center Diphda. It made no difference that I couldn't recall which star was Diphda, for the ETX-90/EC was already heading toward the southwestern skyline. Only one star was visible in the finder when the scope stopped, so I centered it and hit Enter. Within a few seconds "align successful" flashed on the LCD and the motors began tracking.

Jupiter was obvious in the twilight and also easy to locate within Autostar's Object menu. I hit the Go To key and the scope began slewing in the right direction. Time has dulled the memory of my first telescopic peek at Jupiter nearly four decades ago, but I couldn't have been more excited than I was this evening as I watched the giant planet slide into the eyepiece field. Aiming a telescope at such an easy target isn't much to brag about, but the ETX-90/EC is likely to be a first telescope for many people. To have it find Jupiter automatically is simply amazing!

Venus was near the horizon, but the ETX-90/EC effortlessly positioned it within the field of the main eyepiece. A little higher was the waxing crescent Moon. I was a bit surprised when the scope missed this target — in the finder, but not the main telescope. Calculating the position of the rapidly moving Moon requires extremely complex algorithms. Indeed, Isaac Newton is said to have complained to Edmond Halley that thinking about the Moon's motion "made his head ache and kept him awake so often that he would think of it no more." So it seems fair to cut the ETX-90/EC a little slack. Furthermore, tapping the slewing keys for a second or two is all it took to center the Moon in the eyepiece.

Saturn was my next target, and the scope placed it dead center. Almost as fast as I could hit the keys I jumped to Aldebaran, the Crab Nebula, Rigel, the Orion Nebula, Betelgeuse, Castor, and the double star Mizar in the handle of the Big Dipper, which was just kissing the treetops along my northern horizon. As a test, I asked the scope to point to M17 in Sagittarius, but the LCD correctly showed "below horizon."

As with a polar-aligned mount, the altazimuth tracking easily kept objects in



One "aux" port on the scope's control panel is for the optional electric focuser, while the other is for connection to a computer. Unlike other Meade computer-slewed scopes, the "brains" of the ETX-90/EC are in the Autostar rather than the scope's base, so computer control is possible only when the Autostar is attached.

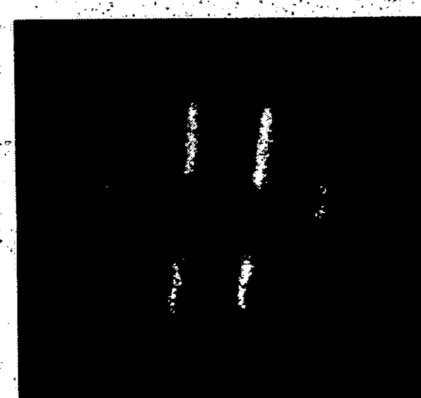
the 48× eyepiece for more than an hour. It even tracked stars effortlessly within 1° of the zenith. When the drive motors operate at tracking speed they make a "stuttering" sound reminiscent of a fax machine — louder than most telescopes, but not annoyingly so — and there appears to be a small amount of vibration. At magnifications of 250× the image sometimes seemed to jitter in synchronization with the sound of the motors. It didn't always happen, but it also seemed too much of a coincidence to be just the jiggling caused by atmospheric seeing. It wasn't enough to be a problem.

The scope moved rapidly between objects, taking just over a half minute to slew the 52° from Rigel to Castor and 45 seconds to cover 101° between Castor and Deneb. A beep that sounds at the end of slewing is not the end of the centering routine; it marks when the scope reverts to tracking mode, after which a few seconds can still be spent automatically refining the centering.

To check the pointing accuracy I used Autostar's internal catalog and the Go To function to slew to more than a dozen bright stars scattered around the sky. All but one lay well within the 1° field of the 26-mm eyepiece.

Autostar's LCD is remarkably robust in cold weather. Coming from a warm house, it was still easy to read after operating for more than three hours at a bone-chilling 10° Fahrenheit. I did, however, have to slow the scrolling speed for the text to remain legible. It's important to have fresh batteries, since a cold-induced voltage drop exacerbated by slewing can cause the Autostar to become erratic. My only field-test failure occurred under just such conditions. Switching the unit off and on cured the problem but required stepping through the alignment procedure again to synchronize the scope with the sky.

In addition to comets and asteroids, Autostar's database includes several dozen Earth-orbiting satellites (more can be added). This is the first inexpensive telescope that is capable of tracking these swiftly moving targets. Orbital elements for satellites grow stale very quickly, and Meade is expanding its Web site so that Autostar owners can download up-to-date elements (this wasn't ready at the time of my tests). An upcoming favorable pass of the Mir space station prompted me to manually update Autostar's orbital elements, which was easily done with Autostar's Edit function. True to claims, Autostar identified the Mir passage. It took only a few keypresses to automatically slew the telescope to the right position and wait for Mir to appear.



The straight bands recorded in this video image from the author's double-pass, autocollimation test with an 85-lines-per-inch Ronchi grating shows that the ETX-90/EC has smooth, well-corrected optics.

The Autostar offers "tours" that are tailored to the present date. They direct observers to showpiece objects, including the Moon and planets if then visible. Most of the objects are accompanied by LCD descriptions. The Moon has different descriptions based on its phase, and prominent features near the terminator are highlighted.

It's exciting to think how the ETX-90/EC can be coupled to a multimedia computer to introduce people to astronomy. Of course, this can be done with most of today's computer-controlled telescopes, but opportunities will be much greater now that the technology is available in a "beginner's" instrument.

Final Points

Price alone makes it difficult to nitpick the ETX-90/EC. At the heart of any telescope is optical quality. Several generations of amateur astronomers have elevated the 3½-inch Questar to icon status because of its fine optics. The three ETXs that I've used have matched the Questars I've tried.

The ETX-90/EC's mount and drive system are not intended for astro imaging. Rather, they are for slewing to and tracking objects for visual enjoyment. They do this very well, though backlash in the gear train requires a deft touch on the motor controls in the altazimuth mode when viewing at high magnifications.

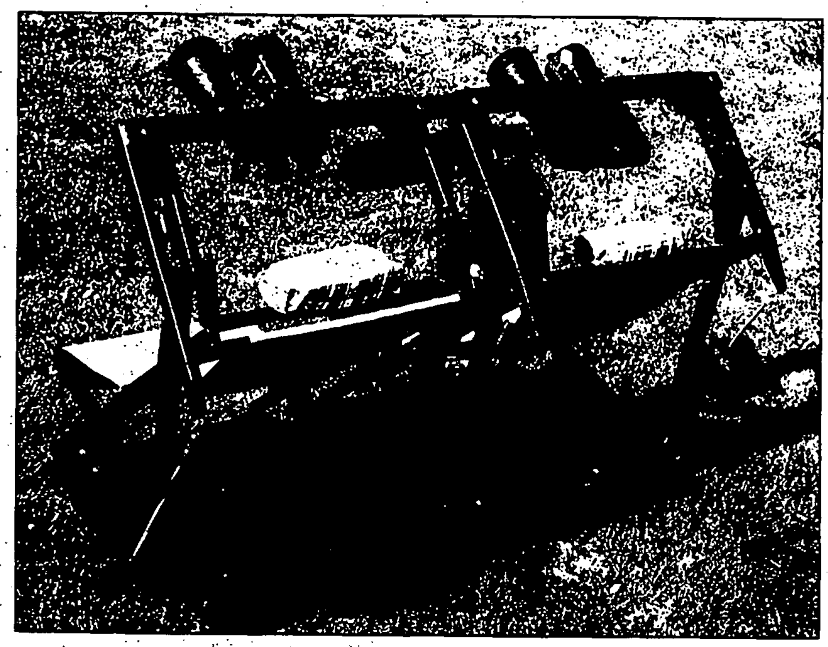
If this were the first telescope with a Go To function, it would be hailed a miracle. Computer-slewed telescopes, however, have been part of amateur astronomy for more than seven years. But you can't compare the Autostar-equipped ETX-90/EC to them, since the nearest competing telescope costs nearly four times as much and still lacks many of Autostar's features.

One final thought. Someone with an affinity for collecting should consider buying an ETX-90/EC and Autostar and pack them safely away. I believe that one day museumgoers will look at one of these instruments in a glass case and read a placard stating that this telescope changed the way everyone looks at the stars.

10 top telescope ideas of 1995
Sinnott, Roger W
Sky and Telescope; Jan 1996; 91, 1; Research Library
pg. 30

10 TOP TELESCOPE *Ideas* OF 1995

BY ROGER W. SINNOTT



Randall and Jean McClelland demonstrate their two-seater binocular chair, where both observers view the same field at once. By simply shuffling their feet they can swivel around the sky without getting out of their seats. The other chairs also swivel. In the version seen at far left in the lower picture, as soon as an object has been located in the binoculars, a rightward roll of the observer's head provides a close-up view with the 6-inch f/4 reflector that also serves as a counterweight! *Sky & Telescope* photographs by Roger W. Sinnott except where noted otherwise.

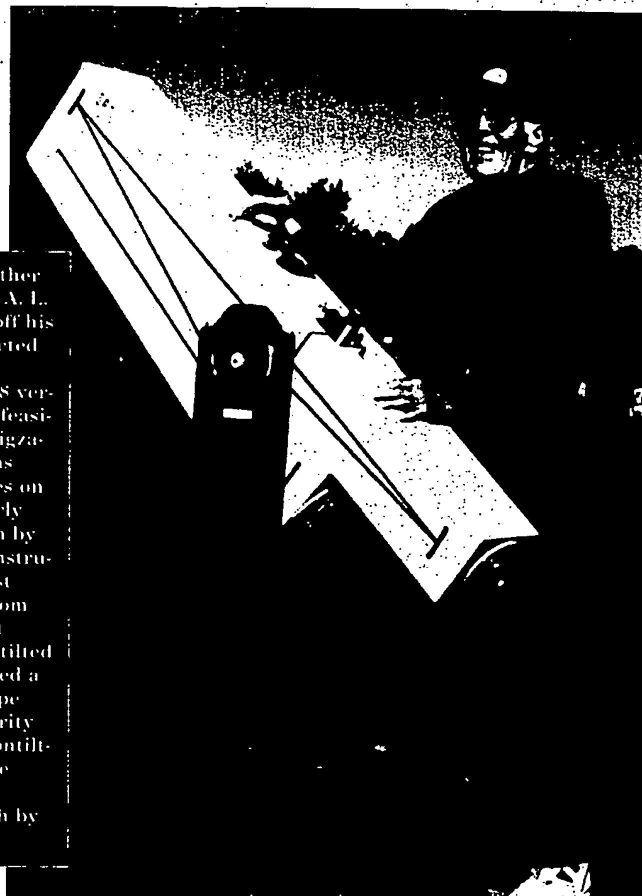
WHAT NEW PATHS are telescope makers blazing today? What changes to our instruments will make CCD work easier? All too often we sit back and wait for new concepts to jump at us from splashy magazine ads, forgetting that commercial products often lag by several years the innovations from clever individuals with home workshops.

Every year *Sky & Telescope*'s editors seek out these creations where the exchange of ideas is especially intense: great amateur get-togethers like Astrofest in Illinois, Stellafane in Vermont, the Texas Star Party, and the Winter Star Party in Florida. Many innovators derive as much pleasure from sharing their insights as they might from turning a profit. Other twists have wafted our way over the transom. We don't claim that all these ideas are new — few things under the stars really are — but all deserve wider notice.

1. Binocular chairs. Numerous stands exist for supporting large binoculars and aiming them to any spot in the sky (*S&T:* June 1993, page 35). But a stand does nothing to alleviate the crook in the neck that often results from such observing, a problem that has long intrigued medical doctor Randall McClelland (2138 Grove Ave., Quincy, IL 62301). Since 1991 he has designed and built six full-fledged binocular chairs, most of which he let people try out at Astrofest last September.

McClelland has found that the secret to designing such a chair is to mount the binoculars so they swing on a pivot arm whose axis passes through the observer's *ears* rather than eyes or neck. The head can then tilt comfortably through a wide altitude range, without the need to readjust a neck rest or back support.

Most of McClelland's chairs swivel on ball-bearing-type lazy Susans of 12-inch diameter, common hardware-store items. His big two-seater rides instead on four casters guided by a central azimuth bolt. The front and back casters are 20 inches apart, while those to the left and right are spaced 24 inches for lateral stability.



"This is not just another schiefspiegler," says A. L. Woods as he shows off his 6-inch f/12 unobstructed reflector at Astrofest. Even an f/8 version would be quite feasible. The light path zigzags through the box as indicated by the lines on the side. Using a fairly recent optical design by David Stevick, the instrument provides almost complete freedom from every aberration but does have a slightly tilted focal plane. It is called a Stevick-Paul telescope because of its similarity (in principle) to a nontilted design by Maurice Paul in 1935. *Sky & Telescope* photograph by Alan MacRobert.

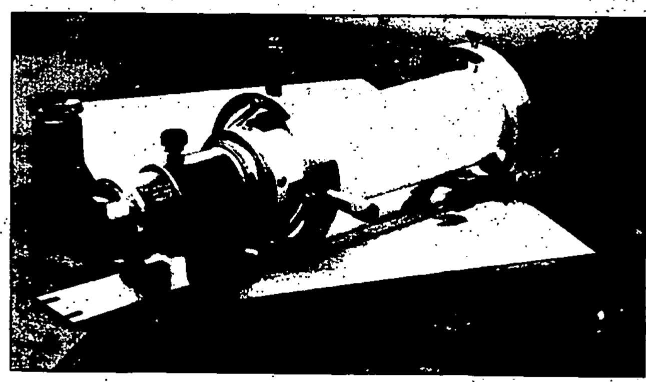
ment contains a paraboloidal primary mirror, a convex secondary and concave tertiary having matching spherical curves, and finally a small flat.

Woods's telescope is based on a design by West Virginia amateur David Stevick that appeared in *ATM Journal #3*, Spring/Summer 1993, the quarterly edited by William J. Cook (17606 28th Ave. SE, Bothell, WA 98012). Annual subscriptions cost $20 in the United States, $30 elsewhere.

5. Guidescope mounts. Traditionally, guidescopes and finders are attached to a larger telescope tube with standoff rings, each of which has three screws 120° apart. But it can be frustrating to change the small telescope's aim, either when aligning it with the main instrument or trying to locate a suitable guidestar. Before one screw can push on the small tube, another screw must be loosened, and the tube never moves in the direction it is pushed.

Connecticut amateur Martin Hamar got the idea for an improved guidescope carrier from his years designing laser instruments. His friend Carl Lancaster (41 Old Orchard Rd., Riverside, CT 06878) then implemented the idea, as pictured below. The skyward mounting ring has the usual three screws and never needs adjustment. The other ring uses two micrometer heads that push at right angles against flat plates fastened to the guidescope tube. A wraparound spring maintains contact.

Martin Lewis (3 Sheaveshill Ct., Colindale, London NW9 6BP, England) brought a variation on this theme to the Texas Star Party. His transportable Dobsonian has a V cutout in the main tube's upper-end ring, within which the finder is attached by a single long screw through the dewcap. The lower end of the finder rests against two nylon adjustment screws at right angles and is held in place by a spring. The finder is easily removed during transportation. "Aligning the finder is now accomplished in a quick and painless manner," he adds.



In the guidescopes made by Martin Hamar and Carl Lancaster (at far right), two micrometer heads, set at right angles, simplify the process of offsetting the tube to find a suitable guidestar. Later, the micrometers can be returned to their zero points when the scope is used as a finder. Lancaster photographs.

Each of Joe Lippl's finder rings contains a single saw cut (that for the rear ring is on the other side, out of view). These permit twisting the finder left or right for alignment. Up-down adjustment is also possible, thanks to elongated screw holes in the mounting stalks. The screws make it easy to pivot the finder down against the main tube when not needed.

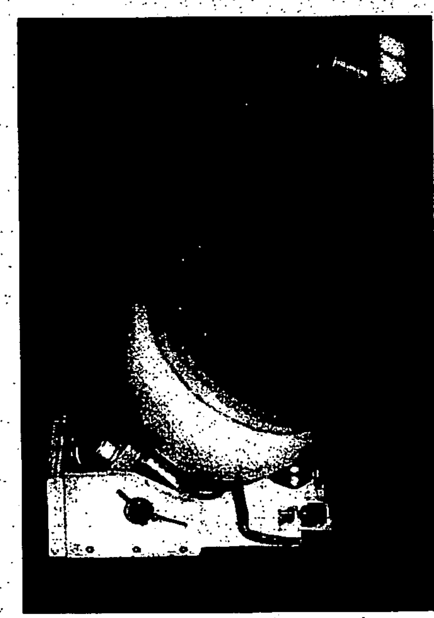
6. Streamlining a telescope. The smaller a reflector is, the more ungainly it looks with the usual rack-and-pinion focuser and finderscope. These components stick out disproportionately, snagging all too easily when the tube is removed from the back seat or trunk of a car. Joe Lippl (10697 Sumac Lane, Sister Bay, WI 54234) showed off his simple solutions at Astrofest.

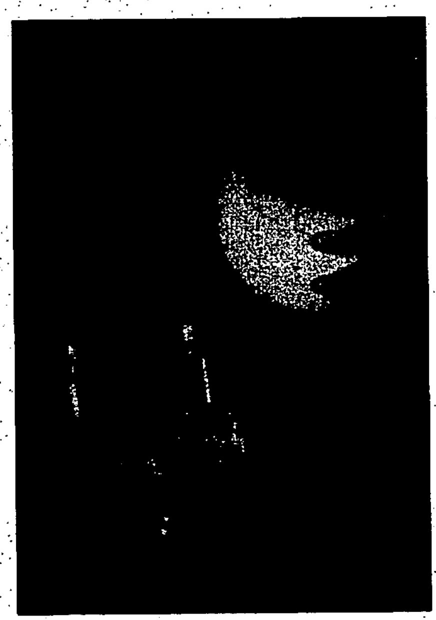
First, Lippl mounted his focuser from *inside* the telescope tube to lower its profile and permit a smaller, less obstructive diagonal mirror. Second, he cut tight-fitting finder rings from thin plywood using a jigsaw. A single saw cut on the side of each ring makes it extremely flexible, permitting the finder to be reaimed through a substantial left-right angle in seconds. There's no fiddling with screws, and once the finder is properly aimed it stays put. Moreover, the rings pivot so the unit can fold down against the main tube during transport.

7. Equatorial sphere mount. The ease with which a telescope on a spherical base can slew to any part of the sky has long fascinated astronomers, but getting such an instrument to track is something else. When he needed a polar axis for star tracking, California amateur Norman James arranged for a motor-driven suction cup to grip the large fiberglass sphere containing his 12½-inch reflector (*S&T:* October 1972, page 237). Belgian inventor Alphonse Pouplier tracks spacecraft with a pair of computer-controlled rollers under his Edmund 4-inch Astroscan (*S&T:* August 1993, page 76).

But isn't there a simpler way? Mechanical engineer Pierre Lemay (112 Alain, Blainville, PQ J7C 2V1, Canada) believes there is. Last July at Stellafane he demonstrated a 6-inch f/4 Newtonian reflector that he had mounted inside a 10-inch classroom globe with its top cut off. This cardboard segment of a sphere, covered with auto-body filler and sanded smooth on a lathe, is supported underneath at three points. Two of the supports are motor-driven rollers inclined parallel to each other at the observer's latitude angle, while the third support is a free-spinning ball like those found in conveyer belts and table-saw extensions.

The two rollers, whose surfaces Lemay sanded rough for better traction, make one full turn every three hours. Their diameters are one-eighth that of the globe, so it turns once in 24 hours for celestial tracking. This unit is the prototype for Lemay's next project, a 20-inch sphere-mounted reflector.

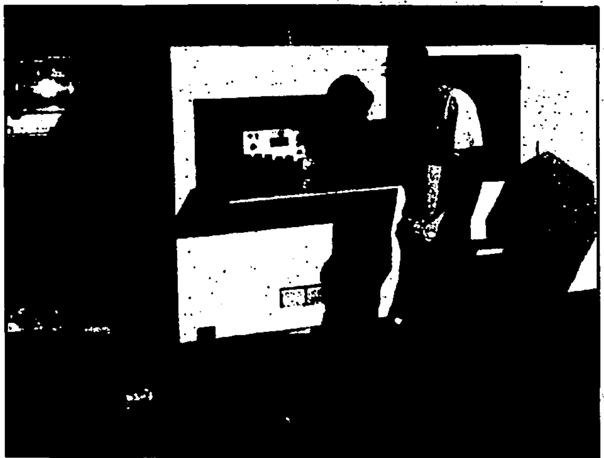




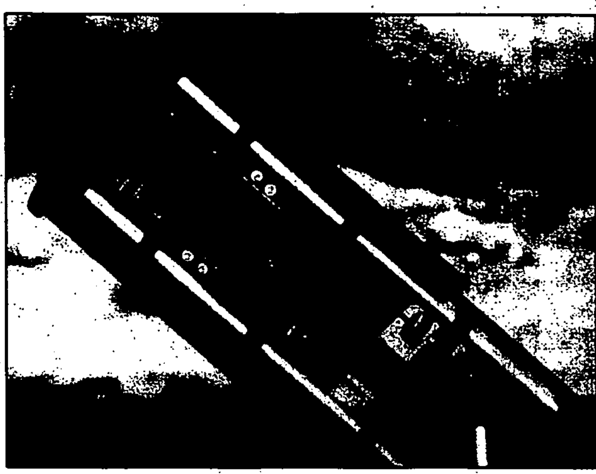
Pierre Lemay's sphere mount includes several adjustments. A wing nut and curved slot on each side of the base allow the rollers to be set for any latitude between 20° and 60°. The vertical control knob is used to fine-tune the polar alignment. Finally, the horizontal knob shifts the free-spinning ball slightly toward or away from the rollers, thereby providing slow motion in declination. *Sky & Telescope* photographs by Chuck Baker.

8. Thermally controlled trailer. A chilled primary-mirror box? A special compartment that keeps eyepieces slightly warm? These are but two of the innovations that Drake Damerau (26503 Nagel St., Roseville, MI 48066) has incorporated in the customized trailer that carries his 20-inch f/5 reflector.

As Damerau barrels down a hot, dusty road to the observing site, his primary mirror sits safe and snug in an insulated compartment through which cooled air is pumped. His thermoelectric unit, cannibalized from a Coleman camping cooler, tries to cool the air to 40° Fahrenheit below ambient. He mon-



As demonstrated at Astrofest, Drake Damerau's climate-controlled trailer uses concealed muffin fans to circulate warm and cold air to the places where it is needed. At remote observing sites all power comes from a pair of deep-cycle marine batteries. Back home in his driveway, Damerau can power the trailer from house current and recharge the batteries as needed.



In Ken Ramsley's telescope, the green knob controls focus while the red knob at far right shifts the entire telescope longitudinally with respect to the single-arm altazimuth yoke. In this way Ramsley quickly restores balance after changing eyepieces. Baker photograph.

itors an external digital thermometer and shuts the cooler off when the mirror has reached the anticipated nighttime temperature. This way he can begin observing as soon as he sets up the telescope, without a cool-down delay.

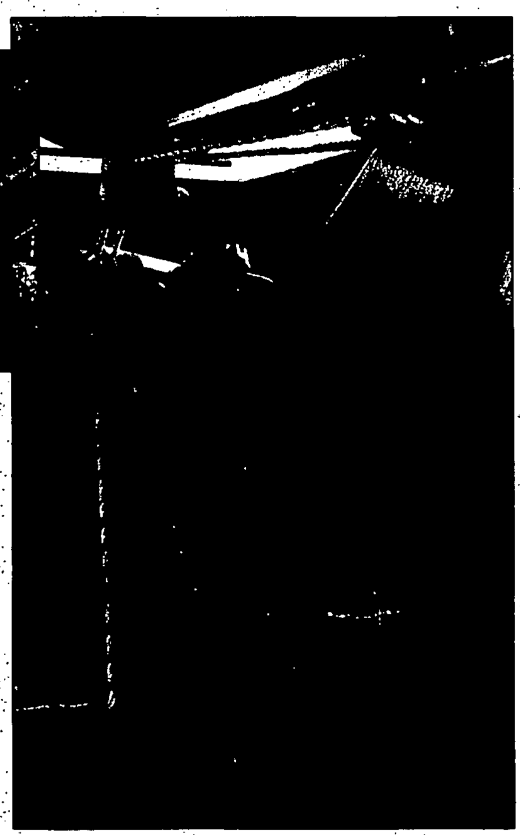
Damerau then folds down a side panel on the trailer to create a horizontal chart table. The exposed recess contains 12-volt accessory ports, a battery-level indicator, a radio and cassette player, softly glowing red chart lights, a digital clock, and a box with holes on top for 12 eyepieces. A rheostat-controlled heater for the air drawn through this box keeps all the eyepieces slightly warm as a dew deterrent.

9. Telescope with balance control. Focusers that carry the diagonal mirror and move parallel to a Newtonian reflector's tube, rather than in and out, are gaining favor among telescope makers. This approach keeps the eyepiece reasonably close to the diagonal, and also provides a firm platform for attaching a camera body. But Ken Ramsley (3 Water St., Ashland, MA 01721) has gone a step further, allowing the *entire tube* of his 6-inch f/5.2 reflector to be shifted with respect to the yoke that carries it. This way he can instantly restore balance after exchanging a heavy eyepiece for a light one.

10. Purposely unbalanced telescope. Then again, does a telescope *have* to be carefully balanced? "No!" says Tony Johnson (2762 Vermillion St., Lake Station, IN 46405), who brought to Astrofest the wooden-fork mount he recently made for his Meade 2080 tube assembly. The declination bearings are attached well up the telescope tube, so the mirror end of the telescope wants to drop — a tendency prevented by a rope continually tugging on the sky end of the tube.

To slew in declination, Johnson loosens the lower end of the rope from its boat cleat, hauls it in or lets it out, and then secures it again as soon as the telescope is pointing roughly where he wants it. He then has available two slow-motion controls in declination: a windshield-wiper motor controlling the fixed end of the rope, plus a hand crank mounted near the eyepiece (see the photographs below). One turn of this crank shifts the telescope about ¼° in declination.

"Having my telescope unbalanced seems to make it more stable," Johnson notes paradoxically. "I can freely interchange eyepieces and accessories of different weights with no concern about image drift."



The rope and pulley system on Tony Johnson's unbalanced telescope evokes the rigging techniques devised long ago for swinging heavy booms on sailing ships. The fixed end of the rope is bolted to a ¼-inch brass pipe tee that he retapped so it would ride along a ½-inch threaded rod controlled by a windshield-wiper motor. Another pipe tee, similarly retapped and riding on the hand-crank rod (arrowed in the close-up), carries a pulley engaging the same rope in the middle. Turning the crank or operating the motor provides slow-motion control in declination. MacRobert photographs.

9/9/12 (Item 3 from file: 141)
DIALOG(R)File 141:Readers Guide

03035138 H.W. WILSON RECORD NUMBER: BRGA95035138 (THIS IS THE FULLTEXT)
This is not your father's telescope.
AUGMENTED TITLE: Meade Starfinder 8-inch f/6 **equatorial** Newtonian reflector
Shibley, John.
Astronomy v. 23 (May 1995) p. 82-5
DOCUMENT TYPE: Product Evaluation
SPECIAL FEATURES: il ISSN: 0091-6358
LANGUAGE: English
COUNTRY OF PUBLICATION: United States
RECORD TYPE: Abstract; Fulltext RECORD STATUS: Corrected or revised record
WORD COUNT: 2041

ABSTRACT: The 8-inch f/6 Meade Starfinder **Equatorial** (around $800) is a classic Newtonian reflecting telescope that can, with a few accessories and modifications, be used for astrophotography. Its aperture allows it to detect deep-sky objects as faint as magnitude 13.3, while its power is sufficient for lunar and planetary observation. Its flexible **mounting** and clock drive allow it to keep an object in view for 10 minutes or more.

TEXT:

It was the quintessential telescope of your father or grandfather's day: the classic, economically priced Newtonian, with its long white tube and German **equatorial mount.** That staple instrument of yesteryear seems eclipsed today by increasingly popular **Dobsonian** telescopes and ubiquitous Schmidt-Cassegrain outfits. Yet the affordable Newtonian design still lives, filling a niche between the former, which can't **track** with the sky, and the latter, which costs upward of $2,000.

While a number of companies market Newtonians in and beyond the price range of Schmidt-Cassegrain telescopes, a handful still offer moderate-aperture, budget-priced Newtonians with **equatorial mountings**. The 8-inch f/6 Meade Starfinder **Equatorial** has features useful to both deep-sky and planetary enthusiasts. Its focal ratio retains the flexibility of wide-field observing without sacrificing higher power for lunar and planetary observing. Because of its clock-driven **equatorial mount**, the telescope **tracks** with the sky, eliminating the need for constant bump-and-nudge recentering. Its 8-inch aperture reaches down to magnitude 13.3 while theoretically resolving 0.6 arcsecond details. And with a few accessories and modifications, the Starfinder can be used for astrophotography. All this for a sticker price of around $800, which includes shipping.

ARRIVAL AND ASSEMBLY

The Starfinder **Equatorial** ASTRONOMY tested was pulled from Meade's inventory and shipped in four parts: the **mount** and legs in one box, the optical assembly in another, and two counterweights packed in separate boxes.

Assembling the **mount** and pier is straightforward. Three legs attach to the pier with wing nuts. Two flexible metal straps bolt to the **mount**'s saddle plate, which secures the optical tube. Two counterweights (one 10 pounds, the other 5) slide onto the declination shaft, held in place by hex socket set screws. In case the weights slip, a retaining washer at the end of the shaft prevents them from falling to the ground.

After unpacking the optical tube assembly box, you install the mirror cell (in which the mirror is already **mounted**) in the tube and then attach the 1 1/4-inch focuser and a 6X30 finder scope. The tube's back end has two sets of three holes that accept the mirror cell: One set, placed farther back on the tube, holds the cell for general observing. The second set, a few inches forward, holds the cell for prime focus photography. (This forward position fully illuminates a camera's 35mm X 24mm field.)

Metal plugs in the **mounting** holes punch out before you use hex screws to secure the cell inside the tube. Both the focuser and finder go on the tube's front end, held in place with nuts and bolts. The secondary mirror and its **mount** is installed at the factory.

Before placing the tube on the **equatorial mount**, loosen a hex bolt where the declination axis pivots in altitude. Align the bolt with a scale on the **mount** (printed in 1 degree increments) so its position reads the same number as your **latitude** and then tighten. This aligns the declination axis with your **latitude**, which is essential for allowing the **equatorial mount** to **track** objects as they move across the sky.

Now all the elements of the Starfinder come together. The optical tube sits on the **mount**'s saddle, held in place by two metal straps. Strap ends slide into slots on the **mount** and tighten with thumb nuts. Loosening the nuts allows the tube to turn and position the focuser for more convenient viewing. Loosened straps also let the tube slide forward or back for proper balancing. When loosened enough, the straps slip out of their slots, allowing you to completely remove the tube from its **mount** for separate storage.

MATERIALS AND QUALITY

The Starfinder **equatorial mount**, painted flat black, is made of cast iron and machined steel components and weighs 34 pounds without counterweights. Its declination axis has a knob that hand-tightens to secure, but not lock, the axis. A Teflon tip presses against the steel shaft but doesn't score it. This allows you to move the scope slightly in declination without having to reach around the tube to completely unlock the knob. An optional tangent-arm assembly ($78) provides manual slow-motion for declination.

To automatically move with the sky, the right ascension axis has an electric clock drive that runs off 120 volt AC house current. A slip clutch allows positioning the scope in right ascension by hand without disengaging the motor. The axes have etched scales for declination (1[degree] increments) and right ascension (5 minute increments). There are no vernier scales provided for finer accuracy.

The Starfinder's 4-foot-long optical tube (15 pounds) is of compressed cardboard painted flat black on the inside, with an exterior tightly wrapped in a spiral fashion with white vinyl tape. Though the tape increases tube rigidity and durability, it makes for a tube surface that isn't smooth; trapped air bubbles between layers are noticeable.

Another drawback of the cardboard tube is that its accessory holes in the tube might fray with repeated use, such as when relocating the mirror cell between its general observing and optimized photography **mounting** points. If you anticipate frequently relocating the mirror for different applications, line the holes with an epoxy glue to prevent fraying.

The Starfinder's 1 1/4-inch focuser is plastic with a metal rack-and-pinion mechanism. It has a two-inch travel that accommodates a wide variety of eyepiece designs. After several observing sessions, the focuser developed a small but noticeable amount of play that, despite some improvement after retightening the rack-and-pinion housing, never completely went away.

While this focuser performs admirably over a wide range of observing, astrophotographers might want to consider installing a beefier focuser, perhaps one that even accepts 2-inch eyepieces, available from Meade or a whole host of third-party suppliers.

At the Starfinder's heart is a full-thickness (1 3/8 inch), 8-inch f/6 mirror made of low-expansion Pyrex glass, housed in a two-piece aluminum mirror cell. The housing that holds the mirror is separated at three points from a plate that attaches to the tube. Compressed springs around the posts at those three points provide tension when the mirror is adjusted during optical alignment, done with wing nuts that stick out of the back of the cell.

The telescope's 1.5-inch minor axis-diameter secondary mirror is housed in a cell supported in the telescope's tube with four vanes. This mirror cell pivots left and right by loosening a nut and turning the cell's support bolt. Three hex socket head screws move the secondary mirror in its cell for fine collimation.

Though Meade says it collimates the Starfinder's optics in-factory, the scope I tested needed adjustment. The manual includes step-by-step instructions on how to collimate the telescope. Collimating the main mirror was quick and easy, but the secondary's tilt screws were coated in black paint, which first had to be removed before alignment. After collimation (which took 10 minutes the first time I did it), the scope held alignment remarkably well, considering the jostling it took getting in and out of the garage between observing sessions.

OBSERVING AND BEYOND

I tested the Starfinder on three separate evenings in temperatures ranging from 15[degree] F to 45[degree] F. Optically, the scope performed beautifully. Detail on the First Quarter Moon was sharp and displayed excellent contrast. Later in the month, when the Moon was out of the way, I enjoyed wispy tendrils in the Orion Nebula and resolved six members of its Trapezium star cluster.

To get you started in observing, the Starfinder comes with a 25mm Modified Achromatic eyepiece that yields a power of 48 and a 50 arcminute (just under 1[degree]) field of view. This serves as a basic low-power eyepiece; two more eyepieces with focal lengths in the 7mm to 10mm and 13mm to 17mm range would serve to round out an ideal collection.

To test the mirror's figure I examined out-of-focus images on either side of a bright star's perfect focus, using a 7mm Televue Nagler eyepiece that gave 171x. At high power, just out of focus, a star's image breaks into a series of concentric rings. If the rings are perfectly spaced and appear identical inside and outside of focus, the optics are perfect. If they seem distorted, the optics still need alignment or some other optical defect may be present (see "Test Your Scope's Optics," July 1994).

When I compared the rings on either side of focus for the Starfinder's mirror, I detected an ever-so-slight intensity difference in the inner ring. This suggests that the mirror I evaluated has a tiny amount of spherical aberration. Being able to detect such a minute flaw is more a testament to the power of star testing; images in focus, for all intents and purposes, still looked very sharp.

The Starfinder's **equatorial mount** is beefy and seems more than adequate to support the 8-inch scope. Even with rough polar alignment, the **mount**'s clock drive kept an object in the field of view of a 13mm Televue Nagler eyepiece (92x, 53' field of view) for more than 10 minutes. Rapping the tube at this power created vibrations that took 3 to 5 seconds to dampen out. After moving to another object in the sky, I detected a 4 arcsecond drift until the clock drive's worm gear took over moving the scope.

As a visual scope, the Starfinder 8-inch f/6 is fun to use and performs well as a deep-sky and lunar scope. With an upgraded focuser and a dual-axis drive corrector, it would also be an ideal scope for a first deep-sky astrophotography rig. One bonus this Newtonian holds for astrophotographers is its long tube; there's plenty of room for a decent-sized guide scope or equipment for piggyback photography.

Combined with its potential and a cost of less than $800, the 8-inch f/6 Starfinder **Equatorial** Reflector proves that an "old-fashioned" Newtonian reflector, the progenitor of most telescope designs on today's market, still holds plenty of promise for the observer and photographer of the 1990s.

Added material

8-INCH STARFINDER **EQUATORIAL** REFLECTOR

Standard specifications

Aperture	8 inches
Focal ratio	6
Primary mirror thickness	1 3/8 inches
Secondary size (minor axis)	1.5 inches
Secondary obstruction (by diameter)	19[percent]
Size of focuser	1 1/4-inch
Standard eyepiece	25mm Modified Achromatic
Finderscope	6X30
Total telescope weight (including **mount**)	64 lbs.
Weight of heaviest component (**mount** with	

counterweights)	49 lbs
Typical selling price	$700
Cost of shipping	$75
Promised delivery time	30 to 60 days
Optional accessories	
#55 slow motion declination control	$78
#47M dual-axis drive corrector(includes #55)	$399
#43 right ascension axis drive corrector	$129

Meade Instruments Corporation, 16542 Millikan Avenue, Irvine, CA 92714-5032, (714) 756-2291

BLACK TUBE STRAPS SECURE the telescope to its **mount**; brass hand knobs tighten the straps. A silver arm with knobs seen below the saddle is the optional tangent arm, which provides manual slow-motion control for the declination axis. On the **mount** proper is the declination lock knob. To the right and below it is a **latitude** scale and locknut. The box in the lower right houses a clock drive motor.

STARFINDER'S PRIMARY MIRROR CELL attaches to the tube just forward of a black tube ring. A metal punch-out tab marks the attach point for astrophotography.

THE SECONDARY MIRROR SITS in a four-vane "spider" **mount**. A center post adjusts the mirror up and down and rotates it. Hexhead collimation screws on the back of the cell provide fine alignment.

CLIPPED INTO ITS CELL, the primary mirror is supported on a **mounting** plate at three points by spring-surrounded posts. Wingnuts adjust spring tension, tilting the mirror cell during optical collimation.

DESCRIPTORS:
Newtonian telescopes; Reflecting telescopes
Product evaluation

9/9/13 (Item 4 from file: 141)
DIALOG(R)File 141:Readers Guide

02281482 H.W. WILSON RECORD NUMBER: BRGA92031482
Three innovations in a **Dobsonian**.
Kelley, William E.
Sky and Telescope v. 83 (June 1992) p. 684-6
DOCUMENT TYPE: Feature Article
SPECIAL FEATURES: il ISSN: 0037-6604
LANGUAGE: English
COUNTRY OF PUBLICATION: United States
RECORD TYPE: Abstract RECORD STATUS: Corrected or revised record

ABSTRACT: The writer describes 3 additions he created for his **Dobsonian** telescope: a spherical mirror that can be bent into a paraboloidal shape by tightening a wing nut, an **equatorial mounting** that is tilted to adjust for the observer's **latitude**, and a **tracking** drive powered by a kitchen timer.

DESCRIPTORS:
Dobsonian telescopes--**Mounting**; **Dobsonian telescopes**--
Control; Telescope mirrors

Attached

Gleanings for ATM's

Conducted by Roger W. Sinnott

Utah experimenter Bill Kelley believes he has opened up a fruitful new field for mirror makers. Here he holds a *spherical* telescope mirror that he parabolizes right at the observing site by applying gentle tension with a screw and wing nut! Back in the 1960's it was a radical departure from tradition when California engineer Arthur S. Leonard used warping harnesses to create toroidal mirrors for his off-axis Yolo reflectors. While the concept is still controversial, mechanical harnesses are also being used on the hyperboloidal segments of the two Keck 10-meter telescopes under construction on Mauna Kea in Hawaii.

THREE INNOVATIONS IN A DOBSONIAN

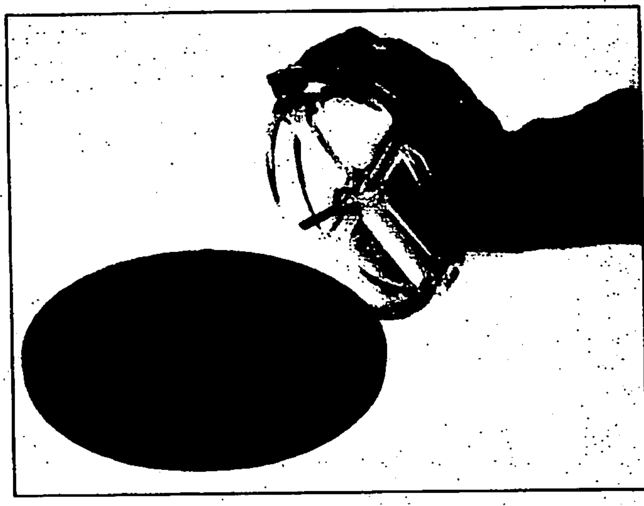
INSTEAD OF OPTING for high-tech approaches, why not try low-tech ones? Pictured here is my 6-inch f/5 Dobsonian equipped, yes, for equatorial tracking. The drive motor is nothing but a kitchen timer. And instead of the usual paraboloidal mirror this telescope has a *spherical* one, bent to a paraboloidal shape with the help of a small wing nut.

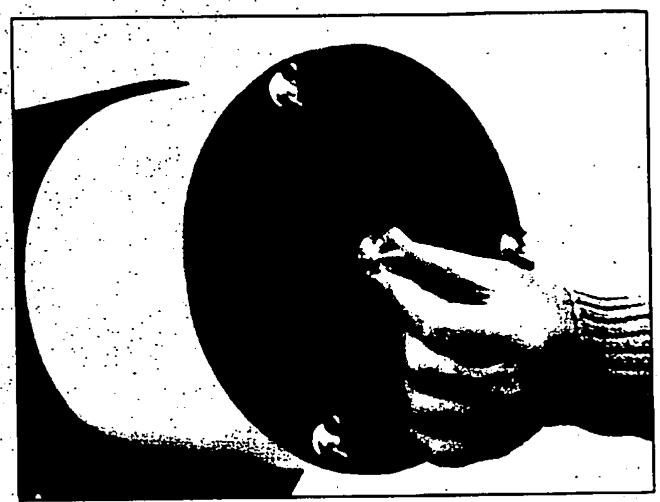
I had purchased a number of surplus 6-inch f/5 spherical mirrors and was faced with the problem of adapting them for use in telescopes. Fortunately, my first simple idea worked perfectly! I epoxied the head of a 10-24 machine screw to the center of the back of a mirror, then placed the mirror on a ring of closed-loop carpeting on a plywood disk with a small hole in the center. The screw projects through the hole, and a wing nut holds this sandwich together. Only the edge of the mirror is supported by the ring of carpet.

At first, when I placed the mirror on a makeshift optical bench and used an illuminated door button across the street as an artificial star, the Ronchi test showed the expected curving bands typical of a spherical mirror used on remote objects, as illustrated on page 686. I tightened the wing nut a bit, and voilà! The Ronchi pattern metamorphosed into the lovely straight bands of a paraboloid. A little more tightening of the wing nut and now the bands curved the other way, indicating a hyperboloidal figure.

Later, with several of these spherical mirrors mounted in telescopes at star parties in our area, I found that an actual Ronchi test is not required to set the correct figure. A couple of tweaks on the tension while observing a star at high power are all you need to sharpen the star images to good pinpoints. Once set, no further adjustment is required.

From this experience I believe a good case can be made for using spherical tele-





Left: Kelley has epoxied a finely threaded flat-head machine screw to the exact center of the spherical mirror's backside. When the mirror is placed on the ring of carpet, the screw projects through a hole in the plywood disk. *Right:* Correcting the mirror's figure is simply a matter of tweaking the central wing nut while examining a star. The other three nuts attach the cell to the telescope tube.

scope mirrors and mounting them in figure-controlling cells, rather than bothering to parabolize. The wing-nut approach certainly works with small mirrors of moderate to long focal ratio. Consider these points:

1. It's much easier for an optician to generate a good sphere on a mirror than a good paraboloid.

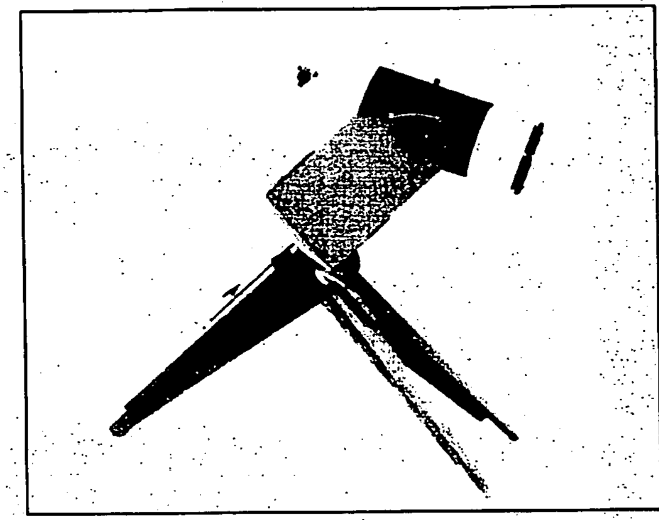
2. *Any* smooth figure, ranging from an oblate spheroid to an undercorrected paraboloid, will do equally well. The wing nut will stress it to a paraboloid. (A hyperboloidal figure would have to be pushed rather than pulled to a paraboloid.)

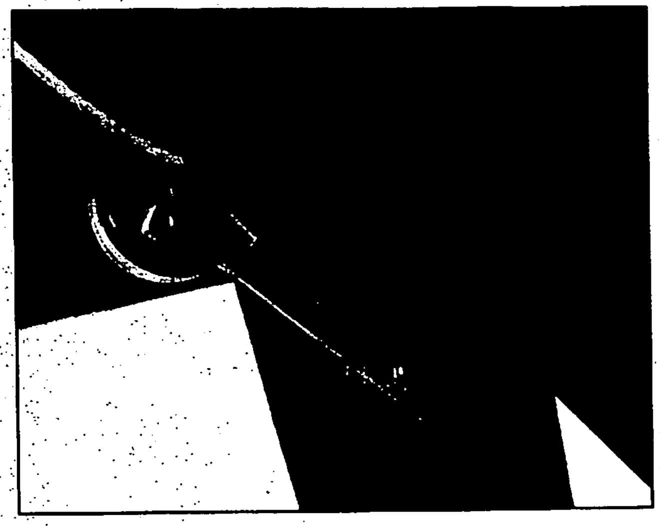
3. No elaborate mirror cell is needed. These mirrors hang comfortably on their mounting bolts.

4. When the temperature drops, as it usually does in the evening hours, some observers have found that a telescope mirror tends to become overcorrected. No problem — just back off a bit on the stressing nut and "tune" the optics to the prevailing conditions.

Perhaps such telescopes might even cost less. (Hubble telescope people, are you listening?)

Dobsonian-style altazimuth mounts are simple and user friendly. At the North





Left: The author's 6-inch f/5 reflector applies tried-and-true Dobsonian ideas to an equatorial mounting. The rocker box becomes a fork, and the azimuth pin is now the polar shaft. While a Dobsonian bearing would have three Teflon pads, the author's tipped-over version retains only two in contact with the smooth disk (in this case, an old phonograph record). The third contact point is now a V block under the central shaft. Farther down to the left is a weight-countering brace. *Right:* The clock drive is nothing but a kitchen timer with its dial replaced by a small friction roller. Rubber bands hold it against the rim of the polar disk while permitting quick disengagement for rewinding. All photographs for this article were supplied by the author.

Pole they would make fine equatorials, but they generally don't tip over very well for equatorial operation at middle latitudes. This is because the bearing pads no longer directly oppose the force of gravity.

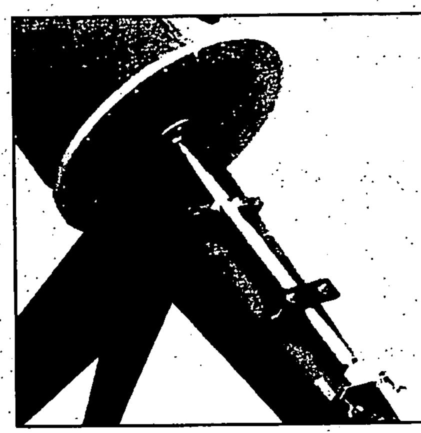
The solution to this problem is simple. Design the mounting from the start to be tilted over by 90° minus your latitude. Extend the azimuth center pin, which normally serves only to keep the rocker box from sliding off the ground board, to become the telescope's polar shaft. This shaft can be made long and sturdy enough to carry a counterweight to balance the overhang of the rocker box and telescope. By resting its upper end in a Teflon-padded V block, we easily satisfy the principle that a three-point suspension is needed for solid support. The other two pads remain under the rocker box.

Instead of a counterweight, I decided to use an adjustable brace (see the photograph at right). The amount of tightening on this brace is not critical. The shaft and fork will slide down until properly seated.

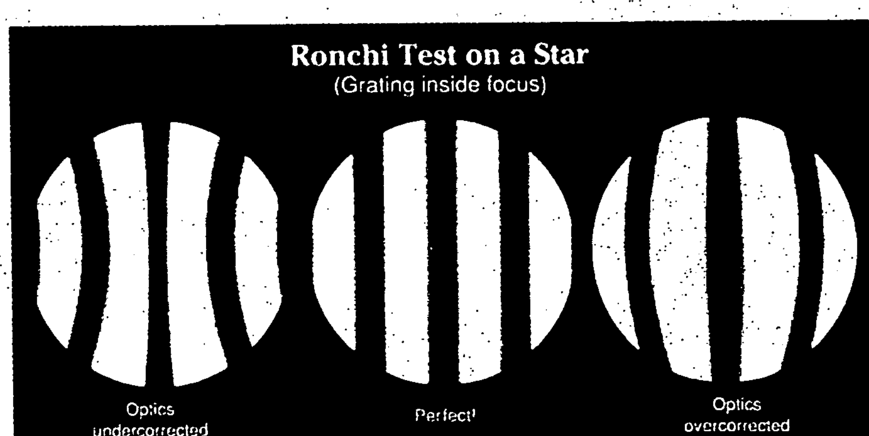
KITCHEN-TIMER DRIVE

For decent tracking in right ascension at public star parties, I've found that a spring-driven kitchen timer of the wind-up type works well. The original dial pointer is easily replaced with a rubber-rimmed toy wheel of the appropriate size. This wheel becomes a friction roller. Most kitchen timers take one hour to make a full turn. The driven wheel on the base of my telescope's fork is 16 inches in diameter, so a ⅔-inch rubber wheel provides the required 1-to-24 reduction needed for sky tracking.

A westward-pulling weight may be added to the fork, if necessary, to help the spring drive along and overcome friction. Rubber bands pull the timer's wheel against the disk. The bell rings when it's time to rewind.



At the bottom end of the polar shaft is a friction-reducing "Bill Kelley device" (BKD), discussed by the author in the July, 1990, issue, page 93. Studs around the polar disk are for hooking on a weight to assist the kitchen-timer drive, in which case the BKD is not needed.



While a Ronchi grating is often used in optical shops to check individual lens and mirror surfaces, it also offers a handy test of a complete telescope on a star, including the effects of a secondary mirror or Schmidt corrector plate (if any). With the star centered in the field of view, the observer carefully removes the eyepiece and replaces it with a Ronchi grating (see page 687). The grating is moved to a point just inside of focus, so that three or four shadowy bands appear projected on the telescope objective (which is flooded with the star's light). The straightness of these bands is a good indicator of the telescope's image quality.

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9/9/15 (Item 1 from file: 484)
DIALOG(R)File 484:Periodical Abs Plustext

04867390 SUPPLIER NUMBER: 61315504 (THIS IS THE FULLTEXT)
Celestron's NexStar 8 go to scope
Di Cicco, Dennis
Sky & Telescope (GSTN), v100 n5, p59-63, p.5
Nov 2000
ISSN: 0037-6604 JOURNAL CODE: GSTN
DOCUMENT TYPE: Product Review-Favorable
LANGUAGE: English RECORD TYPE: Fulltext; Abstract
WORD COUNT: 3821

Attached

ABSTRACT: "We developed the Megawedge,' notes JMI founder, Jim Burr, "because of customer demand. We have the Megapod for the NexStar 5 and the Meade ETX scopes, but the additional weight of the 8-inch called for something heavier:' Made of steel 1/8 inch (3.2 millimeters) thick, and finished in black crinkle paint, the Megawedge is adjustable for any **latitude** on Earth from the equator to the poles. It attaches to all Meade and Celestron field tripods, including those custom made for the NexStar base.

Celestron's NexStar 8 go to scope
Dennis di Cicco
Sky and Telescope; Nov 2000; 100, 5; Research Library
pg. 59

Celestron's NexStar 8 Go To Scope

There's more than just 3 inches of additional aperture in the newest member of Celestron's NexStar family of telescopes. | **By Dennis di Cicco**

S&T TEST REPORT

In a perfect world product reviewers would approach telescopes with an open mind and no preconceived notions. If there's ever been an instrument to remind me of why this is important, it's the NexStar 8 — Celestron's newest entry in the growing market of computerized Go To telescopes that robotically hunt down celestial targets with the push of a few buttons.

Celestron's announcement of the NexStar 8 at the beginning of the year came as little surprise. My *S&T* colleague Gary Seronik and I had just finished weeks of running a pair of 5-inch NexStars through extensive tests for the review that appeared in the February issue. From our perspective it was obvious that the NexStar 5 mount was either destined for a larger telescope or vying for an overkill award. Celestron's decision to outfit the mount with its 8-inch optics was just, well, logical.

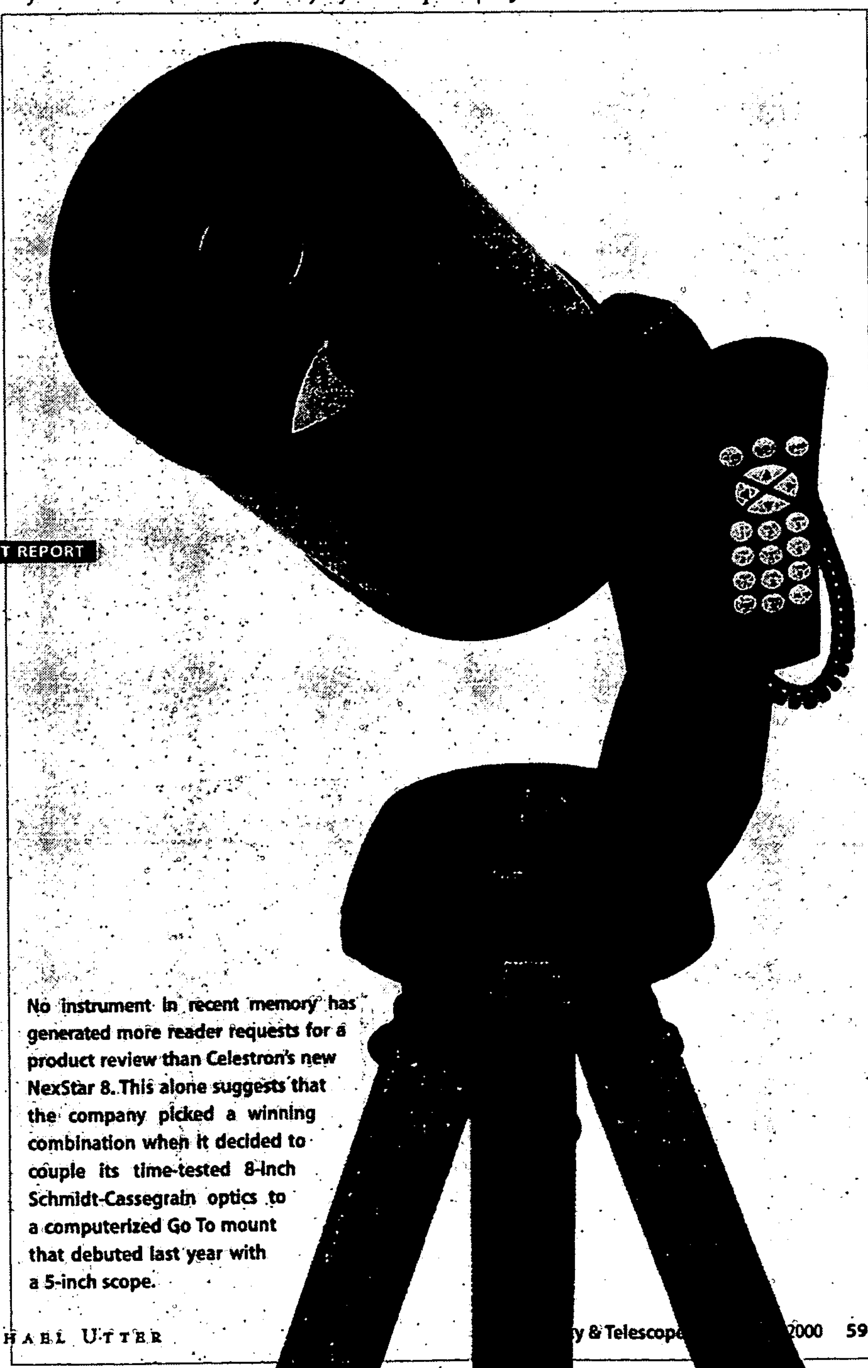
While the new scope didn't come as a surprise, it also didn't seem like an instrument in need of a full-blown review. After all, we had just done a detailed critique of the NexStar system in February, and Celestron's 8-inch Schmidt-Cassegrain optics have been a known quantity in the amateur community for three decades. There were questions about whether the mount and tripod were up to the larger load of the 8-inch scope and whether the computerized pointing would be accurate enough for the inherently narrower field of view. But answering these would be little more than a footnote to the February review. Nevertheless, within days of the NexStar 8's advertising debut, requests for a review began pouring

Celestron NexStar 8

Complete system, including 8-inch f/10 optical tube assembly, computerized mount, and tripod

U.S. Street Price: *$1,899*

Available from Celestron dealers worldwide (see www.celestron.com for a listing)



No instrument in recent memory has generated more reader requests for a product review than Celestron's new NexStar 8. This alone suggests that the company picked a winning combination when it decided to couple its time-tested 8-inch Schmidt-Cassegrain optics to a computerized Go To mount that debuted last year with a 5-inch scope.

Photographs by Craig Michael Utter

While it wasn't always clear from early advertising photographs, the NexStar 8 is indeed an 8-inch f/10 tube assembly attached to the same mount used for its 5-inch cousin. As such, the optical axis of the larger instrument is slightly offset from the base, but this has no consequences for astronomical observing. The 8-inch tube, however, cannot swing down past the base.

into our offices. It was clear that this telescope had piqued the interest of many readers, and we quickly set about revising our review schedule to accommodate the new instrument.

In mid-June we anonymously purchased a NexStar 8 from a major mail-order company in the United States. It arrived via United Parcel Service ground shipment in less than a week, securely packed in two cardboard boxes — one for the telescope and the other for the tripod (which is included with the 8-inch scope but is an option for the 5-inch). Less than 10 minutes elapsed from the time I slit open the boxes until I had an operational telescope sitting in front of me, thanks to the scope being shipped fully assembled (except for the no-magnification Star Pointer finder, which takes only a minute to attach to the optical tube assembly). Mount the scope to its tripod with three hand knobs and pop eight AA batteries into the base and you're ready to go. You don't need a single tool to prepare for a night of visual observing. The NexStar is not intended for long-exposure photography.

The scope comes with a standard 1¼-inch star diagonal and a 40-millimeter Plössl eyepiece that yields 51× and a true field of view ⅘° across. Rounding out the basic package is a wall transformer for powering the scope with house current.

A clear sky beckoned, so I carried the scope outside and set it on my gently sloping driveway. While aligning the finder with the view through the main telescope, I was struck with how solid the system is. A firm rap on the scope produced vibrations that damped in about one second, an amazingly short time for an instrument of this size. This was with the tripod legs in the lowest and most stable position, but even with them fully extended, the damping time was barely more than two seconds. The soft rubber tips on the tripod legs play a major role here — with them removed the vibrations have a smaller amplitude but last at least one-third longer; this is still a remarkably short time, however. The solid mount and smooth, light touch needed on the focusing knob made the scope a joy to use at any magnification, especially very high ones, when even small vibrations are annoying.

The NexStar mount has no manual slow-motion controls, and though there is a slip clutch on the altitude axis, the mount turns in azimuth only with the internal motor, so power is always needed when one is observing. Furthermore, in order for the scope to track celestial objects it must be run through an alignment procedure each time the power is turned on.

When Gary and I tested the NexStar 5s, we usually used the automatic alignment method. In a nutshell, it works this way. The user keys in the date, time, time zone, and observing site's latitude and longitude. (The location information can be stored in permanent memory for future recall to speed the data-input process.) Based on this information, NexStar's onboard computer selects a pair of suitable alignment stars and automatically slews to the first one. The accuracy of this move depends on how carefully the scope is initially pointed north and how level the user sets the optical tube assembly.

If the alignment star is obscured by a tree or building, you press a button to automatically select another star and try again. Once a suitable star is found, you manually center it in the finder (and the main scope for better accuracy) with the slow-motion buttons and hit a few keys, after which the scope moves to a second alignment star and the procedure is repeated.

You don't need to drag an instruction manual outside or commit this alignment sequence to memory, since you can simply follow the instructions that scroll across the hand control's two-line, illuminated LCD readout during the procedure. Once the alignment is completed, the unit begins tracking and you are free to slew the scope around the sky with the push buttons or have the computer do the work for you.

While the alignment procedure is simple, it can still take five minutes or more, especially if any of the alignment stars are blocked from view. I found this inconvenient while testing the NexStar 5 on nights when I just wanted a quick look at the Moon or a planet. Nevertheless, I considered it a minor annoyance in light of the other benefits offered by computer pointing.

On my first night out with the NexStar 8, however, I decided to skip the automatic

The NexStar 8 will accept all accessories designed for 8-inch Schmidt-Cassegrain telescopes. But a 2-inch star diagonal, unlike the smaller 1¼-inch one, will not clear the base and thus cannot be used for observing near the zenith. A slip clutch on the altitude axis prevents any damage from occurring if such a setup is accidentally slewed into the base. Once the clutch slips, the scope must be realigned with the sky before tracking and computer pointing can be accurately resumed.

NexStar's ergonomically friendly hand controller has illuminated buttons that are easy to read in the dark, but in below-freezing temperatures the LCD becomes sluggish and, in the case of scrolling text, nearly impossible to read. The controller can be stowed neatly in the fork arm, where it can continue to be used while one is observing without its illumination being a distraction at the eyepiece.

alignment and use the alternate two-star method. This eliminates all the initial data entry, and I simply had to point the scope at two stars that are on NexStar's internal alignment list, which includes most bright stars. Any beginner with even a modest familiarity with the sky can do this effortlessly. For accuracy's sake, it is best to avoid stars near the celestial pole, at the zenith, or close together on the sky.

Because this manual alignment allowed me to pick only stars that were then visible from my driveway, what had often taken five minutes to accomplish in automatic mode now took less than two minutes to complete. This was much more convenient for those quick-look occasions. The downside was that without the date and time entries, the scope couldn't calculate the position of, and thus automatically point to, objects that move against the starry background, including the Moon and planets. It may seem like a small thing, but for someone with a basic knowledge of the sky, this simplified alignment procedure can make the scope seem a whole lot more user friendly. That was my first unexpected surprise with the NexStar 8.

The next one came as I began testing the pointing accuracy by slewing to some summertime deep-sky favorites. On my own time, most of my visual observing is with scopes of 12-inch and larger aperture, but those I've been reviewing recently have been mostly in the 6-inch or smaller category. I had forgotten just how much an 8-inch shows under even a light-polluted suburban sky!

With the NexStar 8, globular star clusters such as M13 were not the fuzzy glows seen in smaller scopes but patches of countless suns resolved as individual points of fire. The familiar planetary nebula M57 appeared as an obvious smoke ring with some sections clearly brighter than others. The Dumbbell Nebula, M27, was a pair of glowing cones embedded in a hazy gauze of fainter material. The Whirlpool Galaxy, M51, appeared with two clearly defined components, and other galaxies had distinct shapes and internal structure. I became so absorbed in the view that I lost track of the testing I was supposed to be doing that evening and just continued enjoying the celestial scenery.

My last surprise for the night came when I decided to pack up and call it quits. I just picked up the scope and tripod with two hands and walked it into the garage in one trip. At 34 pounds (15½ kilograms) this has to be one of the most portable 8-inch commercial scopes ever made, especially when you consider that it's the complete package, including motor drives and power supply. Dobsonian reflectors have a reputation for simplicity, but after getting the hang of NexStar's computer control (something that anyone can do in a night or two), most people will find this telescope as easy to set up as any Dobsonian and maybe even easier to use. Indeed, an 8-inch Dob that I happened to have in the garage at the time required two trips to carry outside, and I still had to go back for star charts (and a table to support them) when I wanted to hunt down obscure objects that could easily be found with a push of NexStar's buttons.

Gary and I spelled out the pros and cons of NexStar's computer control last February, and that review is also available online at www.skypub.com. On the plus side of the ledger, NexStar

- is relatively easy to learn
- offers direct keypad entry for most Go To objects (no complex, multilevel menu structure)
- has an extensive database of objects (but see below for a note about the star catalog)
- includes short descriptions of popular targets.

On the downside, however, NexStar

- has a scrolling display that is difficult or impossible to read in below-freezing temperatures
- can access the 10,000-plus stars in its database only via a unique number (requires a cross-reference list).

There were several notable differences between this NexStar system and the one we tested with the 5-inch scopes. The new system now includes the Moon as a Go To object. On most nights it did an excellent job centering this target in the eyepiece, but sometimes, especially when the Moon was near the horizon, the Go

Celestron's no-magnification Star Pointer is intuitively simple to use and ideal for aiming the telescope at any object visible to the unaided eye. It is not good for hunting down faint objects by the star-hopping method, but this is irrelevant in light of the scope's computer-pointing features.

To system placed it just outside the field of view. This suggests that the software may not handle the parallax effect, which can displace the Moon up to 1° (but is negligible for everything else). The other major difference is that the new NexStar does not point at targets below the horizon but instead flashes a warning message on the hand controller's display if the user requests such a move. The NexStar 5s we tested were happy to point at anything regardless of whether the object was visible or not.

In other respects the NexStar 8 was mechanically and electrically indistinguishable from the NexStar 5s we had tested. The absolute pointing accuracy was also similar. The longer focal length of the 8-inch scope is partially offset by the lower-power "standard" eyepiece supplied with the instrument. The field of view in the 8-inch is 46 arcminutes across compared to 55 arcminutes for the standard 5-inch setup. Despite the smaller field, the larger scope often got every one of the stars on my test list within the field during automatic slews. And the occasional miss was always just outside the field.

Small rubber tips on the tripod legs help reduce the damping time for vibrations to about one second — an incredibly short time for any 8-inch telescope, particularly one as highly portable as the NexStar 8.

While I didn't keep as accurate records as during the NexStar 5 tests, it did seem that the new scope had its computer crash a bit more often. The problem was still rare and usually involved the display locking up (rather than erratic behavior). Most of the time it happened when I was too eagerly pushing new buttons before previous commands were fully executed. Turning the power off for a second or two always cured the problem but also required the alignment procedure to be repeated before observing could continue.

Because the NexStar 8 typically got less than five hours of operation from a fresh set of alkaline batteries, it was far more economical to use the supplied AC wall transformer. This also eliminated the system crashes that inevitably occur as the batteries become exhausted. There is a small limitation imposed by the wall transformer in addition to requiring a source of electricity. The scope should be switched to the "cord-wrap" mode, which prevents the instrument from unlimited rotation in one direction and wrapping the wall transformer's cord around the mount. This sometimes causes the scope to take the long way around the sky when moving between objects that are relatively close together. For example, on one automatic move I requested going from the double star Epsilon Lyrae to the globular cluster M56 (separated by 11½°), and the scope turned nearly a full revolution on its azimuth axis. Another

Megawedge and Auriga TriPlus

by Dennis di Cicco

S&T TEST REPORT

THE FIRST COMPANY MANY AMATEURS TURN TO FOR telescope accessories is JMI — Jim's Mobile, Inc. And, at present, it's the *only* company they can turn to for an equatorial wedge for the Celestron NexStar telescopes.

"We developed the Megawedge," notes JMI founder, Jim Burr, "because of customer demand. We have the Megapod for the NexStar 5 and the Meade ETX scopes, but the additional weight of the 8-inch called for something heavier." Made of steel ⅛ inch (3.2 millimeters) thick, and finished in black crinkle paint, the Megawedge is adjustable for any latitude on Earth from the equator to the poles. It attaches to all Meade and Celestron field tripods, including those custom made for the NexStar base. Like the lighter-duty Megapod, the Megawedge accepts NexStar scopes as well as all of the Meade ETX models. It also comes with a detachable plate that holds four 1¼-inch and two 2-inch eyepieces. There's a foldaway peep sight to aid in polar aligning the Megawedge. The only thing lacking is a fine azimuth adjustment. To position the Megawedge in azimuth requires the user to turn the whole tripod, which makes small adjustments difficult.

The heavy-duty tripods for Celestron and Meade telescopes make a fine support for the Megawedge. But when you attach the wedge to the standard NexStar or ETX tripods you end up with a rather wobbly system due mainly to flexing in the tripod heads, especially when the NexStar 8 is on the wedge. Surprisingly, this flexure was more of a problem when I was trying to align the wedge than when observing, since the vibration damping time was only about 3 seconds even with the heavier scope.

Auriga's TriPlus is a much more solid support for the Megawedge. Manufactured in Italy and based on an extremely heavy-duty Manfrotto camera tripod, the TriPlus has a custom top plate that accepts the NexStar base. The TriPlus is made of aluminum and chrome-plated steel and has reversible feet with spiked tips on one end and rubber caps on the other. Its height adjusts from 31 to 62 inches (79 to 157 centimeters). Designed for loads up to 66 pounds (30 kilograms), the TriPlus is rock solid. But this rigidity comes with a price. At 18 pounds (8 kilograms) the TriPlus is twice as heavy as the standard NexStar tripod. There is another tradeoff as well. Although the amplitude of vibrations is smaller with the TriPlus, damping time is longer even when the rubber-capped feet are in place. Fitted with a NexStar 8, the TriPlus damped in about 2½ seconds (alt-azimuth configuration) and 5 seconds (with the Megawedge) as opposed to the standard Celestron tripod's 1 and 3 seconds, respectively.

For visual work I found little advantage in

NexStar Support Group

Megawedge

Price: *$119*

Jim's Mobile Inc.
810 Quail St., Unit E
Lakewood, CO 80215
Phone: 303-233-5353
www.jimsmobile.com

TriPlus

Price: *$375*

Auriga
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Celestron's 8-inch f/10 Schmidt-Cassegrain optical tube assemblies have improved over the last 30 years thanks to advances in optical and mechanical fabrication techniques. The NexStar 8 we reviewed was anonymously purchased and had excellent optics that emerged from the shipping box just a tweak shy of perfect collimation (which is critical for optimum optical performance). Collimation is accomplished with small adjustments to three Phillips screws hidden beneath a snap-on plastic cover on the secondary mirror housing.

time, while sweeping a short distance from a globular cluster I targeted as a Go To object, I decided to return to the cluster by hitting the Go To button again, only to find the scope making a full circuit of the sky. It did, however, precisely center the cluster at the end of the trip.

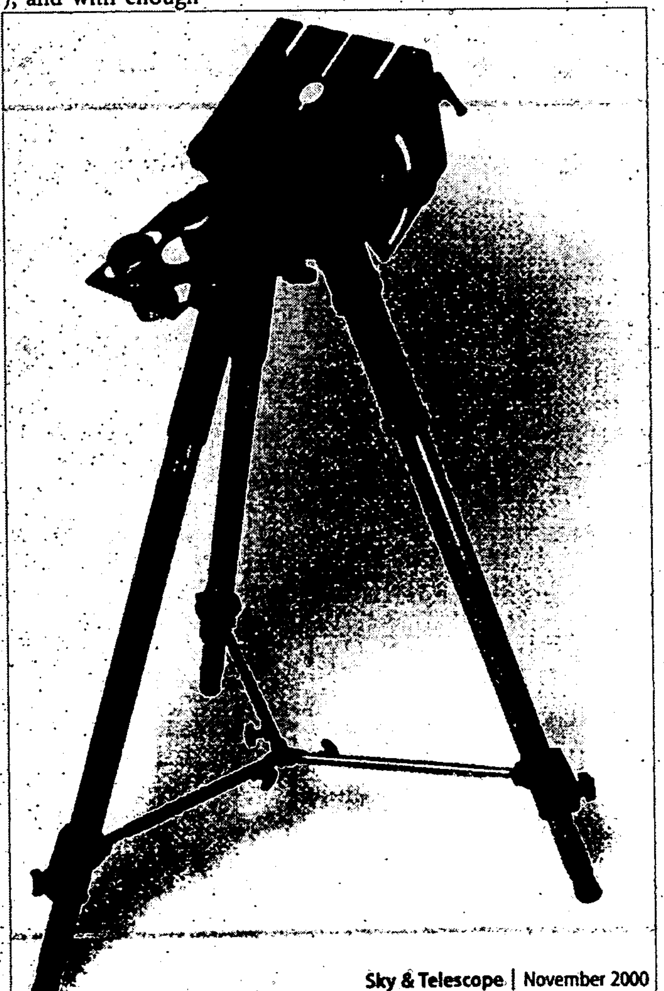
Such long slews usually take less than a minute since the NexStar has a maximum slew speed of nearly 6° per second. The drive motors are speedy yet quiet while slewing and provide smooth tracking. The only complaint I have with the drive system is the same I had with the 5-inch. The electronic backlash compensation, especially for the altitude axis, makes it difficult to "jog" the instrument by small amounts. This was most troubling when I was trying to center objects while viewing at high magnifications. The backlash compensation can be turned off, but this causes long delays when one is trying to reverse direction when the slewing rate is set at a slow speed.

Celestron has yet to introduce an equatorial wedge for the NexStar mount, even though the telescope itself has internal software that allows equatorial tracking. There is, however, a wedge made by JMI (see the box below for a review). In truth, there's little reason for the added complexity of using this scope in equatorial mode, since the altazimuth mode is fine for most visual work. Equatorial mode does, however, allow the cardinal directions in an eyepiece to remain fixed (they rotate as a scope tracks in altazimuth mode), and some planetary observers find this useful.

I came away from my tests of the NexStar 8 impressed with how nice this instrument is for visual observing. Light, portable, completely self-contained (unless using AC power), and with enough aperture to give exciting views of many deep-sky objects, the scope has a lot of potential. And that's not even considering what a boon computer pointing is for many people. During the weeks I worked with the scope, especially after learning the setup shortcuts mentioned earlier, I found myself carrying it out of the garage for "quick looks" even though there was a larger instrument (without computer control) ready to go in my backyard observatory only a few hundred feet away. It's hard to imagine any visual observer being anything but delighted with the NexStar 8.

having the NexStar telescopes polar aligned on the Megawedge. Because these instruments lack setting circles, there is no quick and easy way to achieve accurate polar alignment. Furthermore, in equatorial mode you must use the two-star method to initialize the scopes with the sky for computer-pointing (but this is not needed if you are just doing equatorial tracking). Be forewarned that the alignment instructions scrolling across NexStar's LCD are misleading for a two-star alignment *in equatorial mode*. They tell you to level the telescope tube, when in fact you must point it toward the celestial equator. Even so, I had more trouble getting the scope initialized in equatorial mode, and this resulted in less accurate computer pointing.

The advantages of polar alignment, however, include slightly more accurate tracking since only one motor has to operate to keep objects centered in the field of view. The equatorial drive rate was precise and remarkably smooth for a spur-gear based system. It would certainly be good enough for piggyback photography with moderate-length exposures using wide-angle and normal lenses. And someone up for a challenge could even try guiding exposures made with telephoto lens. I would not, however, suggest that anyone who can't tolerate frustration try guiding the NexStar for any type of long-exposure imaging through the telescope. It just wasn't intended for this kind of work.



The Italian-made TriPlus and JMI's Megawedge offer an ideal solution for people interested in using the NexStar telescopes, as well as the Meade ETX series, in polar-aligned equatorial mode.

64/9/4 (Item 2 from file: 47)
DIALOG(R)File 47:Gale Group Magazine DB(TM)

05169254 SUPPLIER NUMBER: 20803682 (THIS IS THE FULL TEXT)
The Sovietski 6-inch Newtonian reflector.
East, George
Sky & Telescope, v94, n6, p57(5)
Dec, 1997
ISSN: 0037-6604 LANGUAGE: English RECORD TYPE: Fulltext; Abstract
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ABSTRACT: The performance and features of the Sovietski 6-inch Newtonian reflector are presented. This model includes parts such as metal castings, die-cast **equatorial mounting**, rack-and-pinion focuser and a secondary mirror holder.

TEXT:

It's basic, it's Russian, it's very well made, and it might revive a design that once dominated the world of amateur **telescopes**.

A blast from the past! The new Russian-made **telescope** from Sovietski Collection recalls an earlier era - a time when the 6-inch f/8 Newtonian on a German **equatorial mounting** ruled supreme in the world of amateur astronomy. There are good reasons these **telescopes** were once bestsellers. They typically offered solid optical and mechanical performance at an attractive price. But the introduction of highly portable, photographer-friendly Schmidt-Cassegrain reflectors in the 1970s, coupled with a general decline in mechanical quality of the era's popularly priced Newtonians, pushed these **telescopes** to the backwaters of amateur demand. Nevertheless, this Russian import has the potential for reviving interest in the once-dominant design.

The 6-inch f/8 Sovietski **telescope** is a classic Newtonian reflector on a German **equatorial mounting**. While lacking the gee-whiz electronics common on today's top-end instruments, it offers exceptional quality at an attractive price. It also sports an impressive collection of standard accessories, including an excellent 8x50 finder, three eyepieces, a 4x Barlow, a set of filters, a solar-projection screen, and more.

Quality is immediately apparent even before you see the **telescope**. It is shipped in two elegant storage boxes made of heavy, cabinet-grade plywood with finger joints and a clear gloss finish. These boxes have hefty, blackened-steel **hinges**, clasps, handles, and corner protectors. Fully loaded, they are also heavy (58 and 77 pounds), indicative of the sturdy **telescope** within. I was certainly impressed by how well the scope is packed using many **contoured**, foam-lined wooden supports. Nevertheless, once the **telescope** is assembled it is unlikely to go back into the boxes except for shipping or long-term storage, since there are more than a dozen subassemblies.

As I unpacked the parts, I quickly realized how well the Sovietski scope is constructed, with many machined surfaces, quality metal castings, and a beautiful finish. Even the back of the mirror has been diamond generated! There is very little plastic used in the construction. The heavy steel pier is reinforced both on the top and bottom, where the **equatorial** head and legs attach. Strangely, its interior was not painted and had developed a thin patina of rust. Antivibration pads are built into the legs.

The optical tube is aluminum and nearly a tenth of an inch thick, so it will not be easily dented. Its interior is finished with circumferential grooving impressed directly into the metal to minimize light scatter, though the black-matte finish had a few slightly glossy areas. Plastic dustcaps are provided for both ends of the tube and for the focuser.

Assembling the **telescope** is straightforward and takes about 30 minutes. Parts are fastened by a variety of well-designed thumbscrews, all of which are captive, so there is never a question of what goes where. I found fastening each leg to the pier to be a little challenging since the screw must align precisely to engage. After assembly, I noticed that a few joints had slipped, particularly those used to secure the polar-axis

elevation. To prevent this it was necessary to torque the locking bolts quite tightly, assisted by an arm built into the most critical nut.

The only tool needed to assemble the scope is a screwdriver (supplied) to fasten a single retaining screw on the dovetail holder for the finder bracket. The dovetail joint allows removing and replacing the finder without having to realign it with the main scope. If returned to the storage box, however, the finder must be separated from its bracket and alignment is lost.

The **equatorial mount** has some notable features, including preloaded ball **bearings** on both axes. True to its Russian origin, it can be **adjusted** up to **latitude** 70 degrees! Just lift the polar shaft until your **latitude** is set on the built-in scale, and then tighten the central nut and another on a diagonal brace. The machined-steel counterweight is secured on its shaft by a threaded collar that presses four fingers against the shaft much like a machinist's collet. This is very secure, convenient, and does not mar the shaft. This shaft turns with the **telescope**, so it is suitable for carrying cameras and the like.

The engraved right-ascension and declination setting circles are easily **adjusted**. As is typical of German **equatorial mounts**, the right-ascension circle is not coupled to the clock drive, so it must be constantly reset when the scope is being moved from one object to the next.

When the clock drive was turned on it hummed but didn't move. Close inspection revealed that the 12-volt, 60-hertz synchronous motor was not turning. Standard 110-volt house current is stepped down to 12 volts by a large "power pack," which contains a transformer, fuse, and switch. The fuse is not a standard dimension for North America. While spares are provided, you won't find replacements locally. The power pack connects to the **telescope** with a 10-meter (33-foot) cable.

Proper voltage was reaching the motor, so I nudged the exposed rotor with a toothpick and it started turning. It's a little noisy. Because the motor stuck about half the time the power was switched on, I contacted Sovietski Collection about the problem. Although the company did not know that the **telescope** had been purchased by Sky & **Telescope** for review, the call was handled very pleasantly. The defective motor was returned by overnight express and a replacement was shipped the same way. The company even made a follow-up call to check that everything was satisfactory. No complaints with that kind of customer service!

The polar drive has two slip clutches. One is on the worm wheel so the **telescope** can be swung around the sky by pushing on the tube. The other is on the motor pinion so the worm can be turned manually for accurately centering objects in the eyepiece - a feature I have not seen on other modestly priced **telescopes**. Covered ports in the motor housing allow easy access to screws that set the slip resistance of both clutches. The drive had a uniform periodic error of 2 arc-minutes that repeated with each 8-minute rotation of the worm gear.

I collimated the primary mirror, first by sighting into the front of the tube, then while observing a slightly out-of-focus star image at high magnification. The mirror is collimated without tools using hand knobs recessed into the mirror cell, so the tube can rest on its end (during assembly of the **telescope**) without disrupting the **adjustment**. Collimation took only a couple of minutes. The diagonal mirror came already collimated, but the solid, well-designed spider assembly also has collimation screws, should **adjustment** be necessary.

Star testing at high power proved the optics to be quite good. The well-known Double Double, Epsilon Lyrae, was cleanly split and, at 600x, all four components were surrounded by diffraction rings. Views of Jupiter and the Moon were also sharp and pleasing. A knife-edge test on a star showed the mirror surface to be smooth and free of zones, with a good edge. This test also revealed a pattern reminiscent of a paraboloid seen under a Foucault test. Realizing that a spherical mirror looks this way in a star test, I removed the mirror from the tube and performed a conventional Foucault test. It confirmed that the primary was indeed a rather good sphere. Because a 6-inch f/8 spherical mirror produces a one-quarter wavelength error, peak-to-valley, it just meets the diffraction-limited criterion, barring errors from any other sources such as the secondary mirror.

I found centering objects to be quite convenient using the slow-motion

controls on both axes. The screw on the declination axis's spring-loaded tangent arm chattered when turned quickly in one direction. Adding a little grease reduced, but did not eliminate, the chatter.

The rack-and-pinion focuser worked smoothly and has several nice features. By grasping both knobs simultaneously and twisting, I found I could **adjust** the firmness of the motion. The bore is slightly over 1 inches and terminates in a flange with an M44 thread, which is the standard for old Pentax screw-**mount** camera lenses. This is about the same diameter as today's popular T threads but with a slightly different pitch. The focuser threads were cut rather loosely, however, and I could easily spin a T adapter on for a few turns before the threads locked up. While not ideal, it did make for the easy attachment of cameras. Furthermore, because of the focuser's novel design, a conventional 35-mm camera body is within focusing additional **adjustments**.

To use standard 1 -inch eyepieces, an adapter is screwed onto the M44 thread. The adapter and the Barlow lens both have a thumbscrew **bearing** on a recessed ring, which clamps the eyepiece without scoring or scratching. I have seen this welcome design only rarely, usually on expensive equipment.

Three 1 1/4-inch eyepieces come with the scope: 15- and 42-mm Kellners and a 25-mm Plossl. All worked well, though the apparent field of the Kellners is narrow relative to modern designs. In fact, the actual field of the Plossl is about the same as that of the 42-mm Kellner despite offering a nearly 70 percent increase in magnification. The 4x Barlow was a different story. It exhibited noticeable lateral color, and image quality was good only at the center of the field.

The scope comes with six glass filters. They include cyan, yellow, magenta, and red, as well as two neutral-density filters - one for the Moon and the other for solar observing when teamed with a supplied off-axis aperture stop. Each filter has a plastic body and clips to the eye end of the eyepieces. They have a clear aperture of only 1/2 inch, so they cover part of the eye lens of the Plossl, restricting some of the field.

In the interest of eye safety I did not test the solar filter, and I recommend that others avoid it as well. There is always a chance the filter may crack when heated by concentrated sunlight. I suggest that solar observing be done using the supplied projection screen, which has clips to hold sketching paper. The manual does not show how to attach it, so it took me a minute to figure out that it rides on the counterweight shaft. The **telescope** is rotated and slid slightly from the balance point until the eyepiece is in line with the screen. While the setup is convenient for group viewing, I am concerned that no lens cap is provided for the finder. I always cover a **telescope**'s finder when viewing the Sun to prevent the unwary from taking a peek.

The 6-inch Sovietski Newtonian is an excellent **telescope** at a remarkable price, especially considering its features, accessories, and quality.

Sovietski 6-inch **telescope**

Russian-made 6-inch f/8 Newtonian reflector on a German **equatorial mounting**

Sovietski Collection 3450 Kurtz St, Suite C San Diego, CA 921100 Phone: 619-294-2000 Price: $699

RELATED ARTICLE: Clock-Drive Modifications

As explained in the accompanying text, the balky drive motor in the Russian scope was the only weak link in an otherwise very strong chain. Designed for the European community, the original drive had a 12-volt 50-hertz motor and a power pack rated for 220 volts AC. For the North American market, the system was changed to a 110-volt power pack and 60-hertz motor, and the original "50Hz" engraved on the drive housing was rather crudely changed to read "60Hz." While low-voltage AC motors offer some safety advantages in damp and dewy conditions, they are not commonly found in **telescope** drives, and they rule out using conventional accessories like drive correctors.

To improve the reliability of the Russian **telescope**'s drive, eliminate the bulky power pack, and restore the option of using a standard drive corrector, I made a simple modification. The Russian 0.2-rpm motor was swapped for a 110-volt 60-hertz synchronous motor manufactured by Hurst Motors, P.O. Box 326, Princeton, IN 47670 (phone: 812-385 -2564). Because Hurst's 0.2-rpm model is a built-to-order unit, it currently costs $183.50

direct from the manufacturer. However, according to Hurst's Bill Johnson, the motors cost considerably less from dealers. Indeed, I found one in stock for $72.70 at Electro Sales Co., Inc., 100 Fellsway West, Somerville, MA 02145 (phone: 617-666-0500). When not in stock, the motors can take up to 8 weeks to order.

The conversion took about two hours, with half the time spent making a new bracket out of 1/8-inch aluminum plate using a hacksaw and file. The original bracket could also be easily modified to accept the new motor, even by someone with more thumbs than fingers. The drive gear fits on the new motor without modification. A switch and pilot light from Radio Shack cost less than $5, and I scavenged a power cord from an old appliance headed for the trash.

This change offered two additional benefits. The Hurst motor shaft is more rigid than that on the Russian motor, and while it didn't change the drive's total periodic error, it did smooth out minor "jumps." Unlike the original, the Hurst motor is reversible, making it suitable for use in the Southern Hemisphere.

A mechanical engineer with more than three decades of experience as a **telescope** maker, GEORGE EAST frequently reviews products for Sky & **Telescope**.

SPECIAL FEATURES: photograph; illustration
COMPANY NAMES: Sovietski Collection--Products
DESCRIPTORS: **Telescope**, Reflecting--Evaluation
FILE SEGMENT: MI File 47

64/9/7 (Item 5 from file: 47)

03876549 SUPPLIER NUMBER: 13605246 (THIS IS THE FULL TEXT)
Mounting an off-axis Newtonian. (telescope holders) (Telescope Making)
Engelhorn, Craig
Sky & Telescope, v85, n4, p93(3)
April, 1993
ISSN: 0037-6604 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT; ABSTRACT
WORD COUNT: 1225 LINE COUNT: 00089

ABSTRACT: An amateur astronomer constructed an **equatorial mount** designed for an off-axis Newtonian from plywood and metal shafts. The **mount** performed well and provided clear images comparable to six-, seven- and eight-inch refractors.

TEXT:

In this continuation from last month, Illinois amateur Craig Engelhorn tells how he made his unobstructed 6-inch reflector skyworthy.

ONLY BY TILTING the primary mirror can the builder of a reflecting telescope avoid a partial blockage of the light path. It is caused, of course, by the silhouette of the secondary mirror. At the very lowest powers this obstruction can be annoying visually, and at high powers it tends to soften the finest details on the Moon and planets.

However, tilting the primary brings a host of new problems. Not the least of these is a severe aberration that must be compensated by additional optics downstream. While several solutions have been found in the last 40 years, I chose Jose Sasian's recent off-axis Newtonian design for its inherent simplicity.

In last month's issue, page 87, I described the design, fabrication, and layout of the optics in their unusual oval tube. Equally challenging were the **mounting** and final **adjustments** needed to complete this high-performance 6-inch telescope.

THE **MOUNT**

A **Dobsonian mount** might be well suited to this telescope, but I opted for an **equatorial** design so I could easily add a motor drive to track the stars. Besides, a **Dobsonian** is most awkward to use at the zenith, where the darkest sky is. But an **equatorial** is awkward only near the celestial pole, which is not an exciting viewing area.

After reading all the old texts I could get my hands on, I had nearly settled on a fork **mount**. But the split-ring **mount** of the Jim's Mobile NGT-18 reflector intrigued me, and Sasian independently suggested a split-ring as well. The result is what you see here. The plywood ring is 3 feet in diameter, inclined at 45|degrees on the **mount**, and it rides on roller-blade wheels that are recessed into the base. To make transportation easier, the ring lifts off the base and unbolts into three flat pieces.

I chose roller-blade wheels because they have high-quality ball **bearings** and are molded into a very accurate circle. They are narrower than skateboard wheels and easy to recess, giving a clean appearance to the design. Unfortunately, my wheels' rims do seem slightly spongy. As an experiment, I tried replacing them with Teflon pads to make a more rigid contact and increase the amount of turning friction. Currently I am using one wheel and one Teflon pad; the amount of friction seems to be just right. A simple bronze pillow-block **bearing** supports the tail end of the polar axis.

One drawback of an **equatorial mount** is that the eyepiece can end up in awkward positions -- in some situations it may even point straight down! A common remedy is to allow the tube to rotate in its saddle, fairly straightforward if the tube is a cylinder. But my tube is not a cylinder and can't be made to rotate by itself. So I built a short wooden sleeve, cylindrical on the outside and **contoured** to grasp the tube near its lower end. Then I made a **hinged** box with circular openings in opposite ends. This box splits open to accept the tube's cylindrical section and allow rotation.

The declination axles are short lengths of 3-inch PVC pipe bolted to

this same box. The PVC rides in hollowed-out blocks of oak that split apart for easy telescope removal. I glued three Formica pads to the inside of the oak, and as a result the telescope glides very smoothly in declination.

COLLIMATION AND **ADJUSTMENT**

All telescopes require accurate collimation to ensure the best possible images. The off-axis design is especially sensitive in this regard, so I used mirror cells that allow a wide range of **adjustment**. The primary mirror is carried in a University Optics aluminum Expand-O-Cell. I custom-made the secondary mirror's cell to allow **adjustment** in almost every direction, including mirror rotation in its own plane.

My secondary cell is based on a ring of 3-inch-diameter PVC pipe, cut 1 inch long. The PVC holds the secondary mirror and is glued to a plastic disk bolted through the center to another plastic disk. The central bolt allows the mirror cell to rotate. The second plastic disk is **mounted** with three spring-loaded bolts to an aluminum plate. The aluminum plate, in turn, is bolted to its wood backing in such a way that the entire assembly can slide 3/16 inch in any direction. With all these degrees of freedom, I can very accurately **adjust** the tilt angle and spacing between the secondary and primary mirrors.

To star-test the optics I used a jig to hold the mirrors. After setting the required distances and angles as carefully as possible, I aimed the jig toward Polaris. The star's image showed a slight astigmatism -- that is, it focused to a short line instead of a point. So I rotated the secondary mirror to orient the astigmatic line parallel to the optical axis. Then I **adjusted** the secondary's tilt angle until the astigmatism disappeared. At this stage I measured the test-jig angles, then drilled holes in my redwood tube at the proper locations for the primary cell, secondary cell, and eyepiece holder.

Upon finally installing the optics in their real tube, I rushed outside to **adjust** the mirrors and observe. Then panic set in as I saw the star Vega transformed into an astigmatic line 1/4|degrees
long! For a moment I feared that I had made some horrible mistake. Would I have to go back to the drawing board? Spend many hours correcting this problem?

No, I had merely installed the secondary mirror with an improper rotation of 90|degrees
. In one minute I fixed the problem and felt the greatest sense of relief as Vega turned back into a normal star.

PROOF IN THE PUDDING

This telescope gives very good images. At Astrofest 1992 last September, many people seemed pleased with its quality. I overheard several folks favorably comparing Saturn's image to that seen in some of the expensive 6-, 7-, and 8-inch refractors on display.

While the mirror surfaces do not have the optical smoothness they should have, only a very slight difference is detectable between a star's diffraction pattern just inside and outside focus -- a sensitive indication that very little spherical aberration is present. A Ronchi grating, used in place of an eyepiece, shows straight lines all the way to the edge of the primary.

Jupiter's image is superb, a sharply defined disk with good surface detail. Saturn shows nice crisp rings and an obvious Cassini division. I'm extremely pleased with the observing capability my new telescope affords.

I want to thank Larry Kaminky of Earlville, Illinois, for beautifully welding my polar-axis shaft. And I especially thank Jose Sasian for his patience and assistance throughout this entire project. He has given us a two-mirror tilted-component telescope design that even a newcomer can build -- I am proof of that.

SPECIAL FEATURES: illustration; photograph
DESCRIPTORS: Star-gazers--Equipment and supplies; Telescope--Equipment and supplies
FILE SEGMENT: MI File 47

Thread: How can an ATM easily fabricate these EQ platform bearings?

Print
Message: 6649065

FROM: Tom & Lou Krajci
DATE: 09/18/2001 22:00:21
SUBJECT: RE: How can an ATM easily fabricate these EQ **platform** bearings?

> From: "Michael Lindner" <<EMAIL: PROTECTED>>

> I can't see from the video that there's anything unique about the bearings -
> looks like two sectors ala Chuck Shaw. See
> http://www.atmsite.org/contrib/Shaw/**platform**/ for design notes, instructions on
> how to make, etc.

On the page: http://www.johnsonian.com/cool.htm check out the section that reads:

=========================
The Theoretical Development:

With an **equatorial** tracking **platform**, what is needed is to create a low profile table surface which is constrained to rotate about a virtual axis aligned to the pole. This was done quite successfully by ATM's Gee, Poncet, d'Autume, and others. The biggest obstacle faced is how to vary the virtual axis angle to accommodate the various latitude settings. This problem was

never solved....

...Solving the latitude adjustment problem required the development of 3-dimensional **contours** which could change their **bearing** diameter as some function of latitude angle. Figure 1-4 show the concept development.... with the key development being the sweeping of many radii of figure 3 onto a small **bearing segment** (item 27). This is shown in Fig 4, and becomes the rear **bearing block** of the Johnsonian design...and is the basis for filed US and worldwide patent applications.
========================

Then examine the diagrams in fig's 1 through 4.

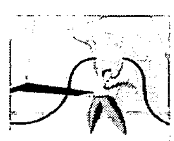
This is not like Chuck's **platform** bearings.

Tom Krajci

EIC 2800

TO: Mark Consilvio
JEF – 3C21
2800

Connecting Examiners to



Critical Prior Art

Darcy Bates
EIC 2800 JEF-4B68
Technical Information Specialist
U.S. Patent & Trademark Office
(571)272-2540
Email: STIC-EIC2800
dbates@uspto.gov

Thank you

Solomon, Terrance

From: Bates, Darcy
Sent: Thursday, August 19, 2004 8:58 AM
To: STIC-EIC3700
Subject: ARTICLE REQUEST FOR ALEXANDRIA CAMPUS

For Mark Consilvio 2800

Please copy article and return to TIS(Darcy Bates JEF-4B68) for review.

Title: **Unknown**
Author(s): Adrien Poncet
Source: **Sky and Telescope vol. 53 or 54, article on page 64**

PTO Main Library Microfilms	QB1 .S5 Microfilm	v.53-54 1977 c.1	Available

Thank you,

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Gleanings for ATMs - An Equatorial Table for Astronomical Equipment

By Adrien Poncet | January 1977, p. 64

The earliest designs for an equatorial platform I could find published in magazines were by Adrien Poncet (*SKY & TELESCOPE*, January 1977, pg 64).

GLEANINGS FOR ATM's

CONDUCTED BY R. E. COX AND R. W. SINNOTT

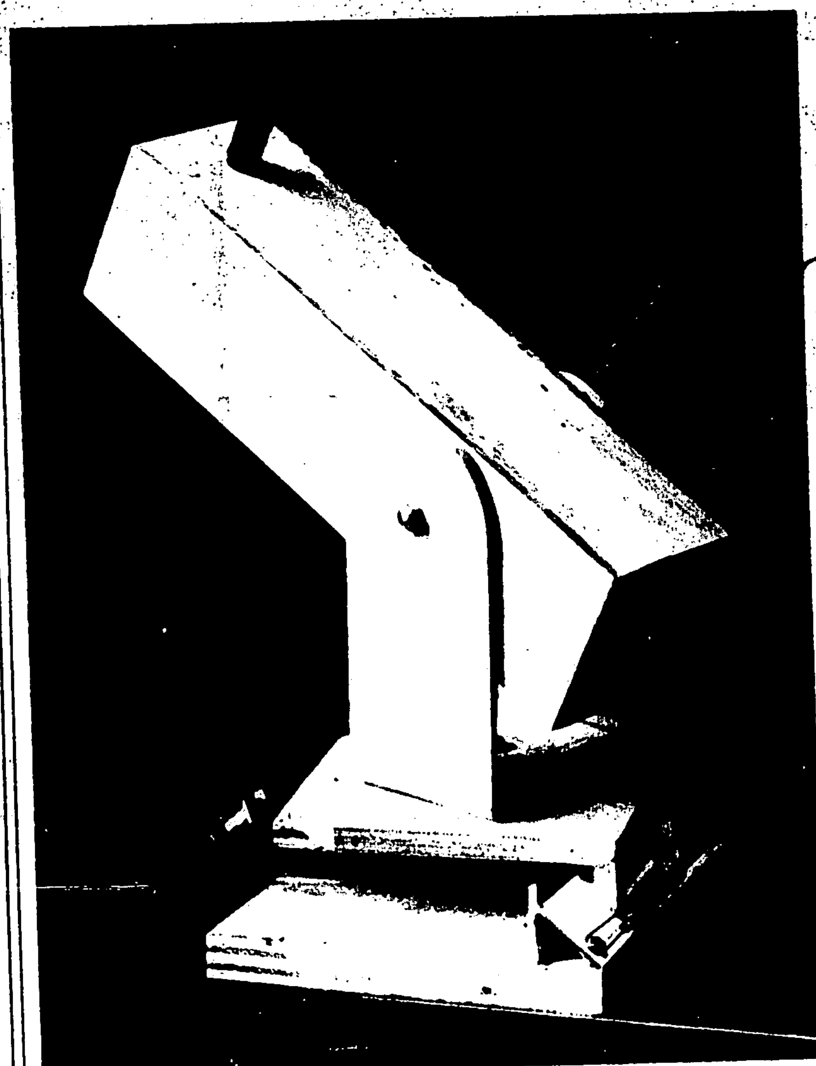
An Equatorial Table for Astronomical Equipment

MOST INSTRUMENTS used in astronomy are supported on equatorial mountings, which have an inclined axis paralleling that of the earth's rotation. This greatly aids celestial photography or prolonged visual use of a telescope, since only one tracking motion is needed to follow the arclike diurnal sweep of stars across the sky.

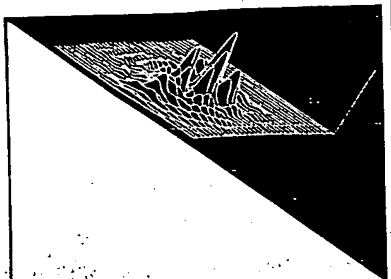
Unfortunately, the common equatorial mounting sometimes places the telescope or observer in an awkward position, and bulky camera attachments can introduce unwanted vibrations and flexure. Several years ago, a novel way around these difficulties occurred to me while considering the following theorem:

> A rigid body that contains three points, one acting as a fixed pivot and the other two being constrained to move in a fixed plane, can only rotate around an imaginary axis perpendicular to the plane and passing through the pivot.

The beauty is that the pivot need not lie in the plane — it can be located above or below it. Moreover, if the plane is tilted



At first glance, this 6-inch f/4 reflector appears to have an altazimuth mounting. But the platform on which the fork rests is pivoted in such a way that only one motion is required to follow the stars. Adrien Poncet of St. Claude, France, believes his mounting is original and describes its underlying principle in this article.



1977-78 WORKSHOPS ON OPTICAL FABRICATION AND TESTING

The Optical Fabrication and Testing Technical Group of the Optical Society of America announces the 1977-78 series of Workshops on Optical Fabrication and Testing. Opticians, Optical Technicians, Optical Engineers, and Shop Personnel are invited to join with their over 2,000 colleagues who have attended the first and second series of meetings.

Emphasis will be on interaction among the various elements of the Fabrication and Testing Community in an informal atmosphere. Sessions will include discussions of tools and equipment, processes, and future requirements.

Manufacturers are encouraged to participate in informal displays of equipment and instruments at each meeting.

TENTATIVE SCHEDULE

June 1977
Danbury, Connecticut

September 1977
Chicago, Illinois

October 1977
Toronto, Ontario

November 1977
San Francisco, California

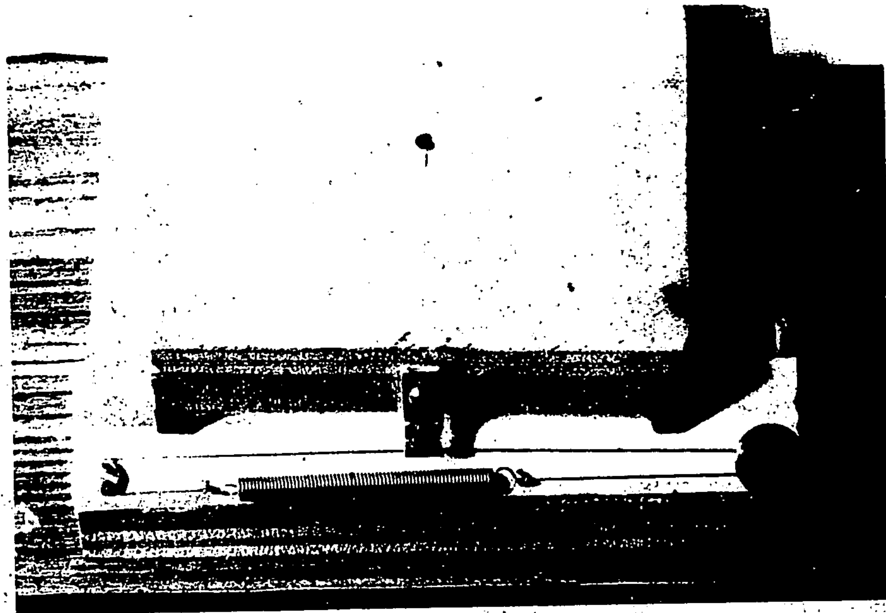
February 1978
Orlando, Florida

April 1978
Los Angeles, California

May 1978
Rochester, New York

June 1978
Boston, Massachusetts

November 1978
Dallas, Texas



Here the 6-inch telescope and fork have been removed. Any other telescope or camera also becomes equatorially mounted when placed on the 12-by-14-inch platform. The drive cable, running on grooved wheels, is kept taut by a spring. For star tracking, the author turns the knob counterclockwise.

to coincide with the celestial equator, a simple equatorial mounting results.

This idea may be carried out in many ways. For an instrument in the Northern Hemisphere, it seems best to place the pivot toward the south and the inclined plane to the north. The working model shown here, for example, is a relatively lightweight structure having static equilibrium on three widely spaced points close to its horizontal base.

The telescope is a 6-inch f/4 rich-field reflector. Most parts are of plywood in thicknesses of 5, 10, or 20 millimeters. The square tube is 62 centimeters long and is carried between two vertical fork arms. The inclined equatorial plane is a 40-by-8-cm. piece of white Formica, which is glued to the large square base through triangular wooden blocks. These tilt the plane upward from the horizontal by 44°, the complement of my 46° north latitude.

An object anywhere in the sky is easily located by turning the telescope on the horizontal and vertical axes of the fork. Then, rotating a control knob causes the beveled strip on the north edge of the fork support to slide on the Formica, imparting equatorial motion to the telescope. About an hour of tracking is possible before the platform must be repositioned.

With its vertical fork, this mounting shares some of the well-known structural advantages of the altazimuth mounting.

the telescope's center of gravity being directly above the supporting members. But with a true altazimuth (such as the Soviet 6-meter telescope), celestial photography requires simultaneous movement around the horizontal and vertical axes as well as rotation of the plateholder in the focal plane. My sliding table, like a classical equatorial, needs but one motion.

Since first described in our amateur magazine *Ciel et Espace*, mountings of this variety have been tried with satisfaction by many telescope makers in France. I would like to hear of similar experiments elsewhere.

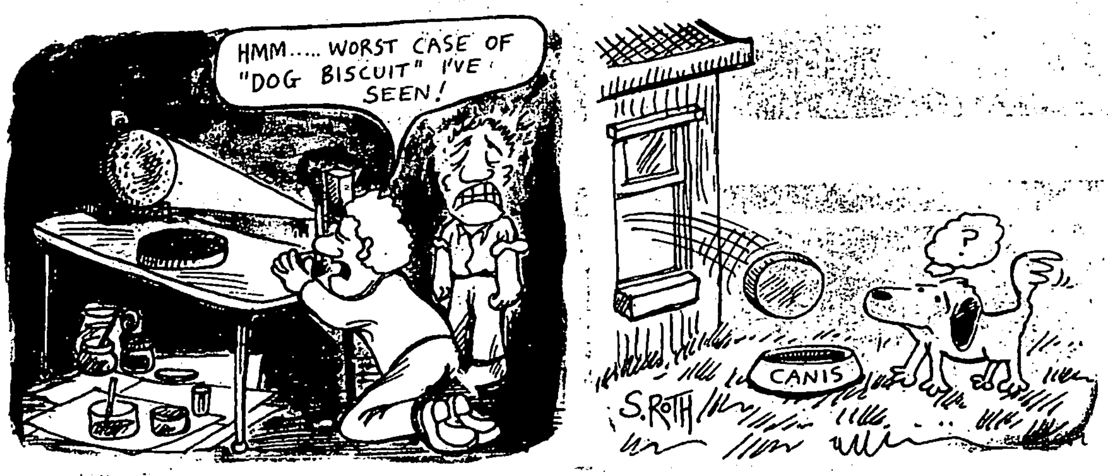
ADRIEN PONCET
7, Boul. de la République
39200 St. Claude, France

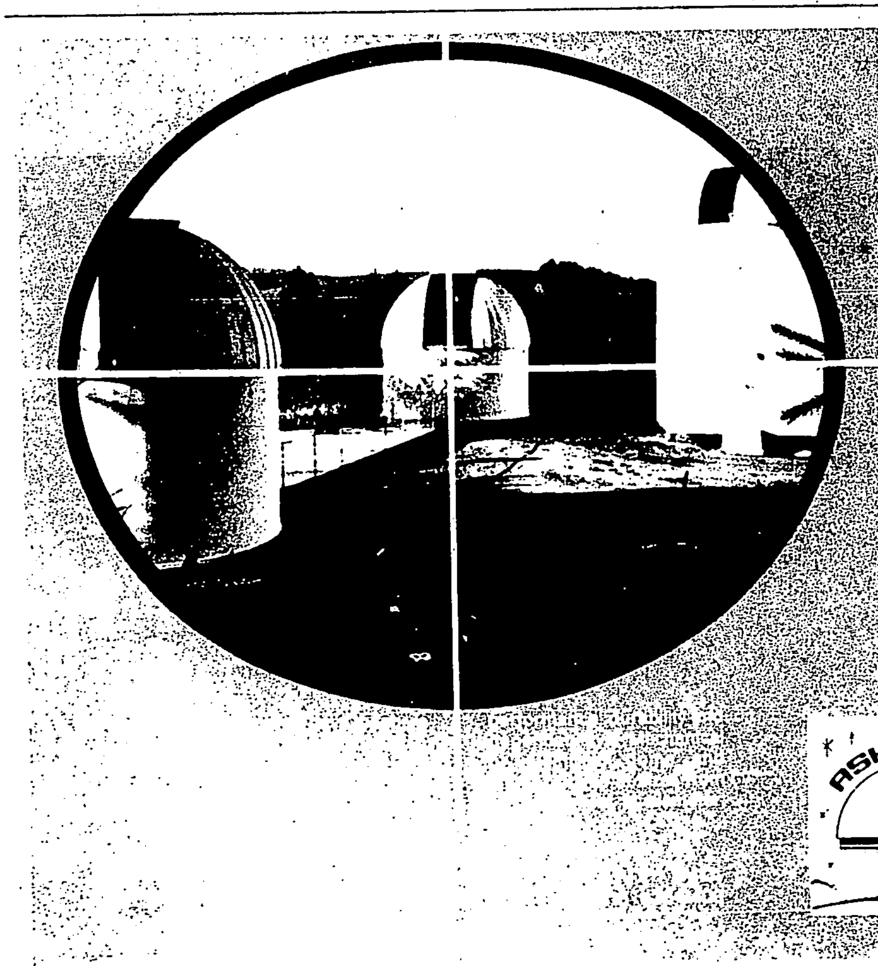
EDITOR'S NOTE: Pictured opposite, my model of the Poncet mounting was built in three evenings from odds and ends. While sawing, drilling, and sanding, I wondered where this unusual equatorial lies in the evolutionary scheme of established types. (See, for example, Russell W. Porter's Part III of *Amateur Telescope Making — Book One*, or Barbara Shutt's diagram on page 294 of this magazine for October, 1976.)

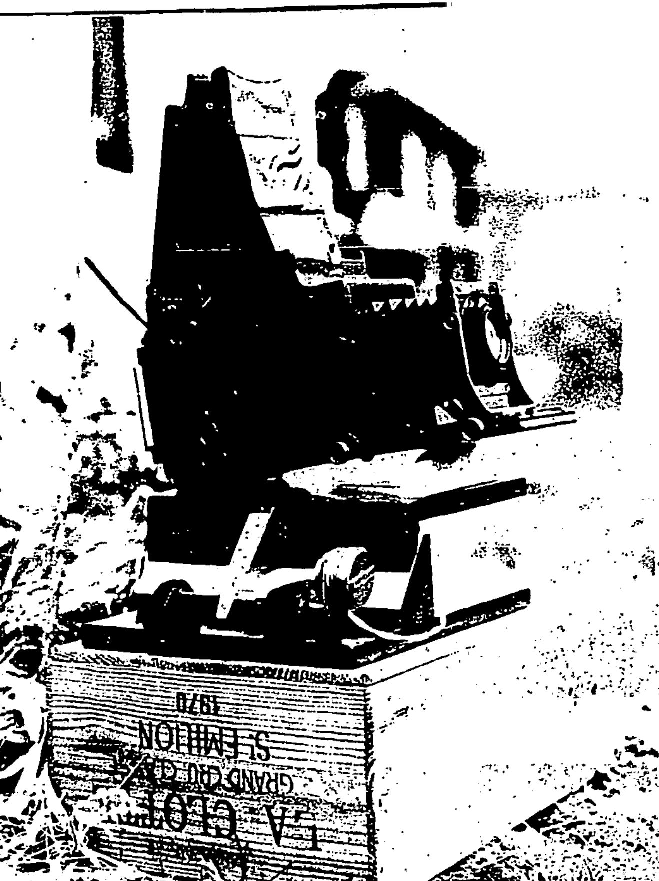
Strangely, the Poncet equatorial table seems to defy classification. In essence, it has no round parts — no shafts, rollers, trunnions, or circular track. It makes use of the most primitive bearings known to man: a plane surface and a pivot. In my model, the pivot is a metal rocks in a conical depression plate.

The sliding table has a pola none in declination. Thus set are out of the question, and unorthodox slow-motion contro leveling screws) are required. tion of tracking is limited, eit construction or by excessive Also, the mounting is not apt in latitudes less than 30° b equatorial plane becomes too support much weight.

But the Poncet mounting has welcome features not often en It makes a fine workhorse pl which variou or telescopes tached inter with little reg ance. Further fairly easy to side of th frame horizon spring, when of photograph et West arriv AND TELESCO percentage ha zon running across the f cause German al mountings





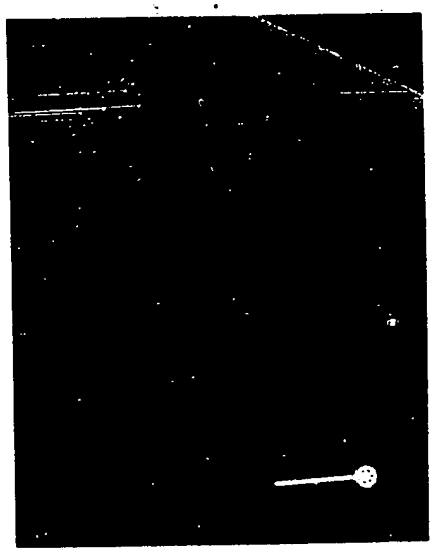


A vintage Graflex camera, designed for 3¼" by 4¼" glass plates, is propped up on Roger Sinnott's Poncet mounting as if a planetary configuration in the western sky were being photographed. The drive for this table is a 1-r.p.m. synchronous motor, 10-24 threaded rod, and tangent arm. Exposures as long as 53 minutes are possible; then the sliding table is lifted off its pivot (hidden here) and Formica plane, and the traveling nut is twirled back to its starting point at the right.

When a heavy camera like the 8¼-pound Graflex is on my table, the drive's action is not perfectly smooth. The table advances in short jerks, each with an amplitude of five or 10 seconds of arc. This rhythmical skidding of the felt-on-Formica bearing is inconsequential in wide-field photography, but it would blur a highly magnified lunar or planetary image.

Better bearing materials, such as brass shoes on a steel plate lubricated with graphite, would probably cure this fault. If so, a sealed-up Poncet mounting could easily handle a rather heavy telescope.

R. W. S.



Jupiter and the Pleiades were Mr. Sinnott's test objects on December 1st. After their images had trailed a few minutes, he switched on the drive of his Poncet mounting for several more. The bright gibbous moon prevented a longer exposure that night.

GLEANINGS FOR ATM's

CONDUCTED BY ROGER W. SINNOTT

SPIN-OFFS OF THE PONCET MOUNTING

SINCE ADRIEN PONCET described his "equatorial table" in this department for January, 1977, many amateurs have tried out this new form of telescope mounting. It has the advantage of providing a practically horizontal platform upon which a variety of visual and photographic instruments may be conveniently placed and operated. If sturdily built, a Poncet mounting requires only a minimum of counterbalancing and has the natural stability of the altazimuth type.

Yet, unlike the altazimuth, a Poncet mounting can be made to follow the stars with only a single driving device. Observing times as long as an hour or even 1½ hours are possible before the table and telescope or camera require repositioning. The platform can be made so large as to include the observer, or even several of them, as was achieved recently in southern England.

This month, however, let us begin our excerpts from the Gleanings mailbag with a few Poncet mountings that bring out the inherent simplicity of the design.

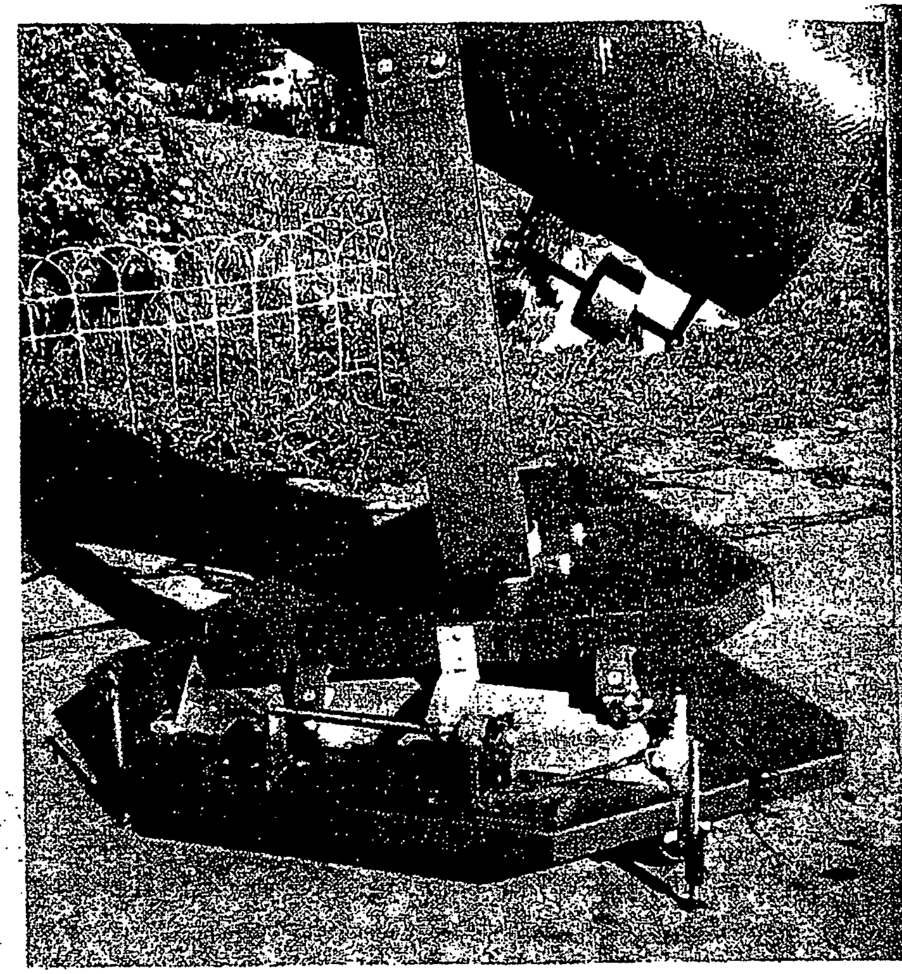
Camas, Washington. "After reading Adrien Poncet's article, I got the bug to put a fairly large telescope on such a mounting. While in California, I acquired a Meade 10-inch f/6 mirror and other parts, then purchased the tube locally."

So wrote Irvin Ulver to this department in May, 1978. "My equatorial platform is a 22-inch triangle with a knuckle-bearing pivot, and the inclined plane is a 3-inch aluminum angle inverted to give a 45° surface (shimmed to match my latitude of 45°.5 north). Two 1¼-inch ball bearings give a nearly frictionless motion to the table. The 1-r.p.m. motor turns a $^1/_{16}$-14 rod, giving me over a full hour of uninterrupted tracking, and there is a microswitch shutoff. The hinged driving arm is taper-bored from the back side so there is no binding on the drive screw.

"The tube of the 10-inch reflector can be lifted from the fork and stored in a cradle for traveling. In Camas it is cloudy most nights of the year, so the ready portability of the Poncet assembly is very important when I make trips to the sunny side of the Cascade Mountains, for example to Goldendale Observatory about 90 miles east of here."

Kirtland, Ohio. The use of ball bearings, as just described, to ease the table motion is a departure from the sliding contact of the original design. But Charles W. Stine, W8LAG, found another

In Irvin Ulver's 10-inch f/6 reflector, the triangular plate to which the fork is attached has an underlying three-point support: a pivot at the right vertex and two ball-bearing rollers on the opposite side. The mounting may be called a Poncet type because the two rollers ride on an inclined plane, elevated from the horizontal by an angle equal to the complement of the observer's latitude (see the close-up on page 164). Mr. Ulver's fork is cut from a 20-inch square of 3-inch plywood, and it is mounted on a 4-inch cage having top and bottom tapered roller bearings with a tension adjustment.

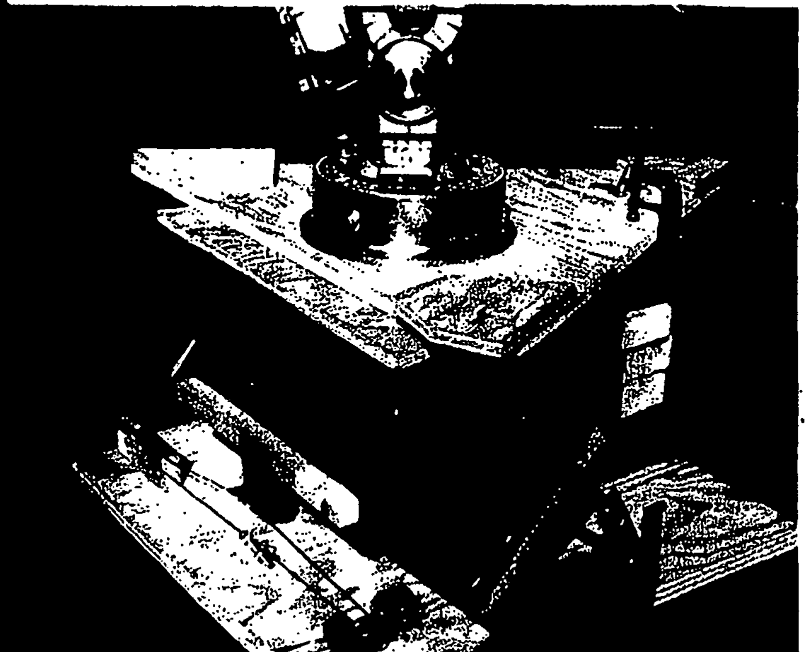


The tangent arm of the Ulver telescope is here set to its starting position, ready for an hour of uninterrupted tracking. The celestial pole lies in the direction perpendicular to the plane on which the rollers move. Therefore, we can deduce that the telescope in this picture is aimed toward the northeastern part of the sky.

way to cope with friction in his small table, which resembles the prototypes pictured three years ago.

"At first I had trouble with the 'rhythmical skidding' of the table on the Formica face of the inclined plane, mentioned by R. W. Sinnott (January, 1977, page 67). But on my Poncet mounting the problem was cured with small pieces of Teflon ribbon stapled across the two contact feet. The action became as smooth and regular as on any mount I have ever used. In fact, the coefficient of friction is so low that the table tends to slide downhill. When driving beyond the table's center (horizontal) position, I use a small counterbalance to prevent the tangent arm from sliding away from the drive nut."

Sainte-Foy, Quebec. Interested in seeing how a Poncet table would work in star-field photography with his 35-mm camera, Jean-Pierre Bernier in only a few evenings assembled the mounting seen on page 165. "I used pieces of wood and metal found in the basement, and a nail



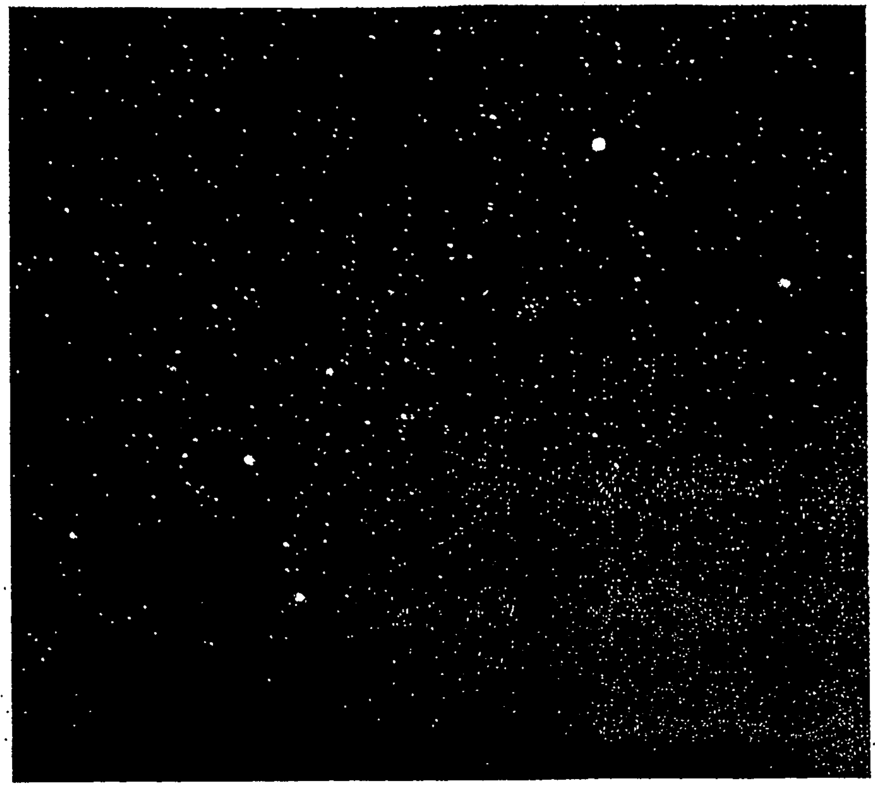
In Sainte-Foy, Quebec, Jean-Pierre Bernier put together this no-frills Poncet mounting to try out the idea, and he has used it to take star photographs like that on the next page. For tracking, he turns the knob in the foreground above slowly by hand, while observing a guide star at high power with the 3½-inch Questar telescope, thereby taking advantage of the fact that everything placed on a Poncet table partakes of the same equatorial motion. A mock-up like this allows measurements to be made before final construction, while possessing all the stability of a finished Poncet mounting. At this stage of experimentation, Mr. Bernier was using an inclined plane of flat glass.

punch for the fixed pivot. This appears to be a very good idea, and anybody can build a Poncet table without buying precisely machined parts. In our high latitude (47° north) it works quite well for photographs of the constellations."

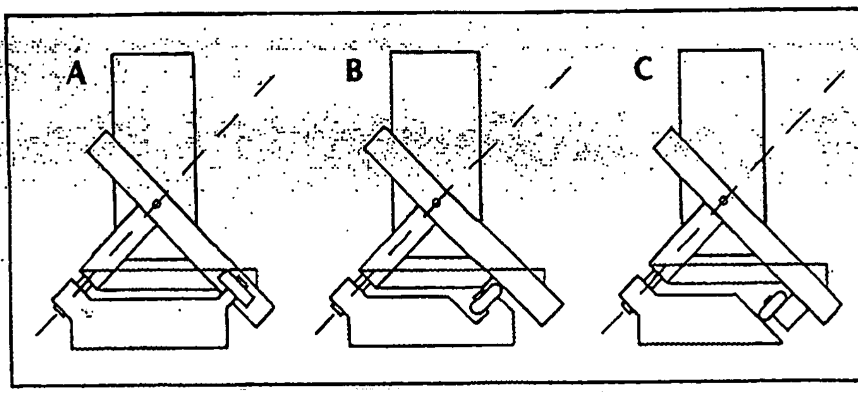
Mr. Bernier is a past president of the Quebec Centre of the Royal Astronomical Society of Canada.

Sunnyvale, California. Many readers are familiar with the split-ring mount, as exemplified in Russell W. Porter's Garden Telescope of the 1920's. It has the advantage of a low silhouette (although the Newtonian eyepiece travel is rather rapid during observing), and is very solid and smooth in operation. Alan E. Gee, well-known for his chapter in *Amateur Telescope Making — Book Three*, writes:

"Mr. Poncet's very clever equatorial platform can be considered a variant of a broad class of telescope mountings that employ a lower pivot point and an equatorial ring carried radially on two spaced rollers. The split-ring equatorial is the leading member of this class, and is shown at A in the accompanying sketches [see below]. In B the roller bearings are on the side of the ring, and C is the same with the plane and roller bearings interchanged. In each case, the red lines show the transformation to a nearly horizontal table, simply by eliminating all of the structure above it.



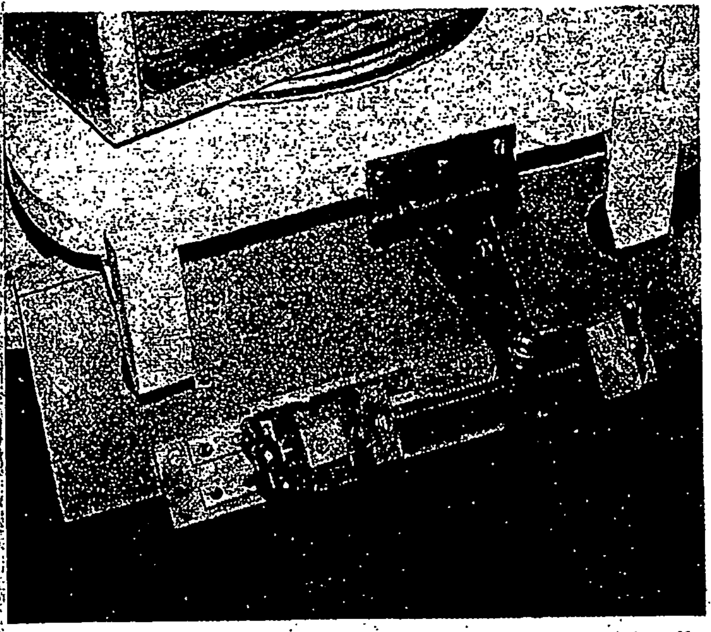
Mr. Bernier's photograph of Canis Major was taken with the setup illustrated on page 165. This is a five-minute exposure on Kodachrome 64 film, using a 55-mm lens at f/1.4. Notice the small clump of stars, two-thirds of the way from the tree horizon to the bright star Sirius; these belong to the open star cluster Messier 41.

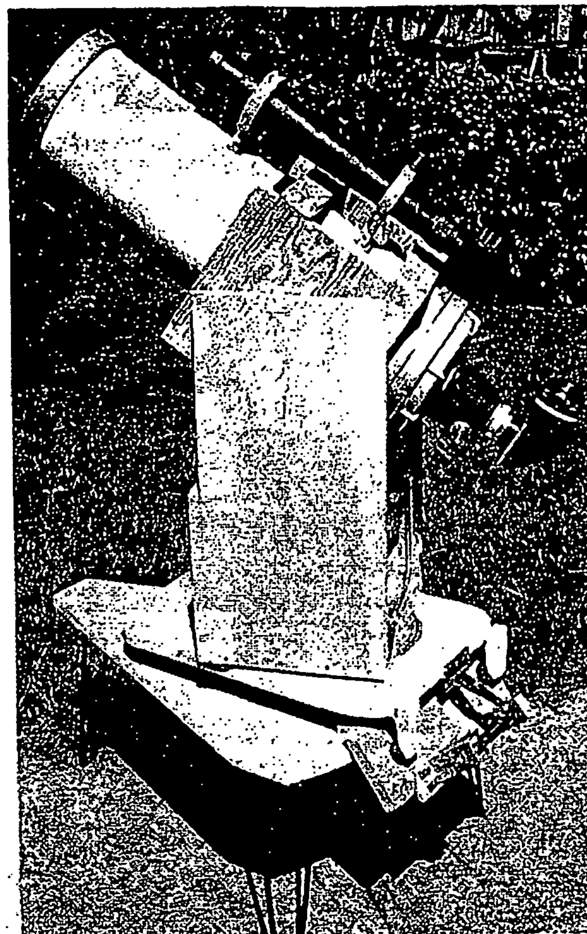


Alan E. Gee prepared these diagrams to show how equatorial tables can be derived from split-ring mountings (see text). "In *B* and *C*," he comments, "I didn't try to get fancy and show the rollers toeing inward."

"Aside from the obviously limited range in hour angle in C, these three variations are functionally the same for infinitely stiff structures. However C, Mr. Poncet's, is superior to B in the real world because droop causing the rollers to slide on the plane does not disturb the polar angle, which is determined *solely* by the plane.

"I suggest that some ATM's try the version indicated by the colored lines in A, which is structurally the best of the three except for ease of construction. The moving parts are fully constrained, the rollers are loaded radially, and the segment of the equatorial circle on which they bear can extend to the top of the platform for more hour-angle range with no restric-





The 8-inch reflector of Kenneth Landon is mounted on a fairly tall fork, stiffened by shelf brackets and a backboard, so that the eyepiece will not collide with the mounting when he is observing near the zenith. High-elevation viewing is further aided by the use of an 80°, rather than 90°, prism ahead of the large Erfle eyepiece; Mr. Landon's friend Don Krieger made the housing that adapts the eyepiece and unusual prism to the telescope's 2-inch focuser. In the close-up of the Poncet drive, above, note that the connection between the hinge and the drive nut must leave the hinge free to twist slightly, to avoid binding at the extremes of table position. Problems of this kind are encountered in almost any application of the tangent-arm principle.

tion of platform area. Of course, it is easy to elaborate on an idea after someone else has been smart enough to think of it in the first place."

El Cerrito, California. Although Kenneth W. Landon's 8-inch Dall-Kirkham reflector has a conventional Cave equatorial mounting, the Poncet table pictured above was built for use when the telescope is taken away from the bright skies of the San Francisco Bay area. Mr. Landon writes:

"The altitude and azimuth bearings are the type intended for making 'lazy susans,' and the polar pivot is the ball-bearing assembly of a chair caster. Because the telescope tube weighs 30 pounds, friction on the Formica board was a problem, until I used plastic tops of Kodak 35-mm film cases for the two sliding contacts.

"The tangent arm is just a door hinge, driven by a threaded rod with handles for manual turning. A Cassegrain instrument lends itself to this mounting, eyepiece and controls usually being close at hand. With low powers, objects are easily kept centered in the field of view. With high powers, when vibration is a problem, I simply turn a handle to bring an object to the eastern edge of the field and let it drift across.

"About 10 years ago, I was one of several dozen amateurs who were allowed to do our optics at Tinsley Laboratories in Berkeley, while our tubes were worked on at the Telescope Makers Workshop of Chabot Observatory in Oakland. I built a 2½-inch finder working at 18x and equipped with an Amici prism to provide an erect, nonreversed field, so that Vehrenberg's *Atlas of Deep-Sky Splendors* can be conveniently used for locating objects.

"Through the 8-inch with a 1¼-inch Erfle eyepiece, the view at 90x is almost a degree across. I like the combination of large apparent field with this giant eyepiece and large image size given by the telescope's 128-inch focal length. Many deep-sky objects, such as the Orion nebula, stand out much better when surrounded by the wide, dark field that this arrangement provides."

2/3/1 (Item 1 from file: 47)
DIALOG(R)File 47:Gale Group Magazine DB(TM)

02332460 SUPPLIER NUMBER: 02575076
Equatorial tracking with a **Dobsonian**: gleanings for
ATM's. (amateur telescope-makers) (column)
Baetens, Chris; Kinnet, F.; Sinnott, Roger W.
Sky & Telescope, v65, p85(2)
Jan, 1983
CODEN: SKTEA DOCUMENT TYPE: column ISSN: 0037-6604
LANGUAGE: ENGLISH RECORD TYPE: CITATION

10 top telescope ideas of 1998
Roger W Sinnott
Sky and Telescope; Jan 1999; 97, 1; Research Library
pg. 135

10 Top Telescope Ideas of 1998

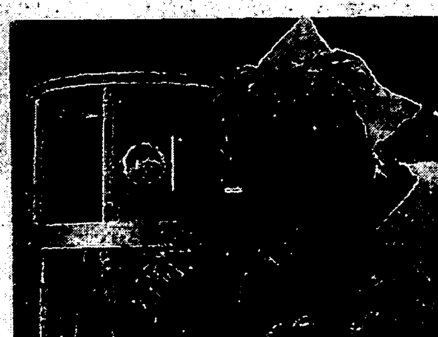
WHAT BYWAYS ARE BEING EXPLORED BY TODAY'S AMATEUR TELESCOPE MAKERS? WHICH new materials are they trying out? Each generation of innovators seems to regard telescope drives, focusers, and observing aids in a whole new light. Never content to sit back and wait for the big companies to develop their commercial products, these individuals like to roll up their sleeves, head for the workshop, and put their own ideas to the test.

By Roger W. Sinnott

Each year the *Sky & Telescope* editors seek out these creations where the cross-pollination is especially intense — at annual star parties like those in Texas and Connecticut, up on Breezy Hill at Stellafane in Vermont, or out in Illinois at the popular Astrofest gathering. Exhibitors at these meets happily exchange their ideas, while many others this past year have sent their suggestions directly to our magazine. We don't claim that all these ideas are new — as few things ever are — but this year's selection, as always, is well worth sharing with our readers around the world.

Salad-Bowl Scope

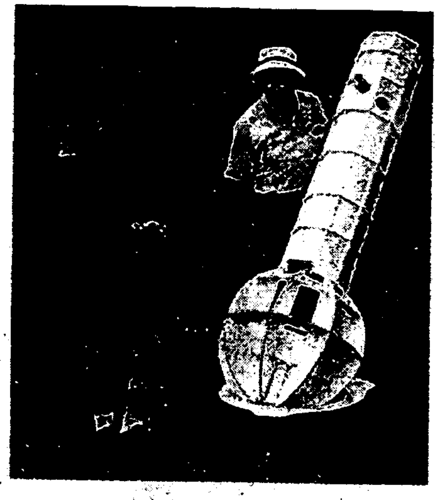
The list of components in Emily Orzech's 6-inch f/6 reflector reads like a shopping list of art supplies, kitchenware, sporting goods, and items found along the plumbing aisle of a hardware store. This 13-year-old says she tinkered with her design for six years before bringing the result to Stellafane last July. The Dobsonian base turns on three hockey pucks and uses a pair of PVC drainpipe covers for altitude bearings. The primary mirror sits in a wooden salad bowl. Counterbalanced by a dumbbell, a long security bar from a sliding glass door extends skyward, carrying a painter's palette for the eyepiece holder and a BB-gun sight. (There's even half of a toilet-lid hinge somewhere on this scope!) Orzech lives at 521 Hillwood Ct., Greensboro, NC 27410-5613. Except where noted, the *Sky & Telescope* photographs in this article are by Roger W. Sinnott.



S&T / ALAN M. MACROBERT

Remote Mirror Collimation

If the tube of your Newtonian reflector is longer than your own arm, you've got a collimation problem. You can't reach the primary mirror's adjustment screws without taking your eye from the eyepiece holder, but that's where you need to be to see the effect of each tweak you make. Unless a second person is on hand to help, it's easy to forget which screw does what as you go bobbing back and forth between opposite ends of the telescope. In order to eliminate this inconvenience, Richard Parker (459 Gebring Rd., Tolland, CT 06084-3613) installed two long threaded rods on the open-frame tube of his 12-inch f/5 reflector. As he demonstrated at the Connecticut Star Party in September, he can turn wooden knobs near the eyepiece to adjust two of the three support points under the primary; the mirror's third support point is fixed. Recently other amateurs have contrived even fancier collimation gadgets, using power-screwdriver motors or radio-controlled servos intended for model airplanes, but we've yet to see anything like this on a Newtonian reflector sold commercially.

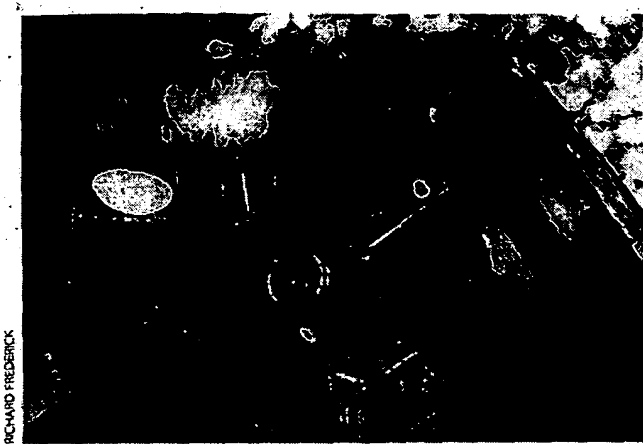


Ball Mounts Galore

Every telescope that rotates on mechanical axes has a blind spot — a certain part of the sky where slewing becomes awkward or well-nigh impossible. Equatorial mounts don't work smoothly near the celestial pole; Dobsonians and other altazimuths can't sweep directly overhead. For this reason more and more amateurs are experimenting with the "no axis" qualities of the ball-and-socket approach. For Bob Carruthers (37 Saw Mill Dr., Wallingford, CT 06492), a professional chef, a skillet lubricated with Mazola Oil is the perfect support for his bowling-ball-mounted reflector *(right)*. Randall Wehler (1105 SW 6th St., Willmar, MN 56201; e-mail: cwehler@mail.tds.net) is just as pleased with the smooth action of his 6-inch f/10 refractor on a dog-food dish *(top right)* from Wal-Mart. But Claudio Fabi (646 Old Connecticut River Rd., Springfield, VT 05156-9174) needed something much bigger than a bowling ball for his 10-inch f/5.6 reflector *(top left)*. He simply cut a series of "latitude" and "longitude" circles out of plywood and built a pseudosphere 23½ inches in diameter. Ski wax improves the motion — and also prevents squeaks.

Pump-Up Pier

Over the years many ingenious chairs and ladders have been designed to bring an observer comfortably to the level of a telescope's eyepiece. Much less commonly has the opposite approach been tried — engineering a pier that can raise or lower the telescope itself to suit the observer's pleasure. At the Texas Star Party last April, however, Franiscek Olstowski (4010 Cedar Gardens Dr., Houston, TX 77082-4006) showed just such a device. He invited Buster Wilson (in the yellow shirt) to press a button on a hand paddle, activating an air pump. Slowly the refractor and its mount began to rise, in gentle but comical spurts, until the eyepiece reached a convenient viewing height. Then Olstowski opened a bleeder valve and *hsssss*..., back down the scope went!



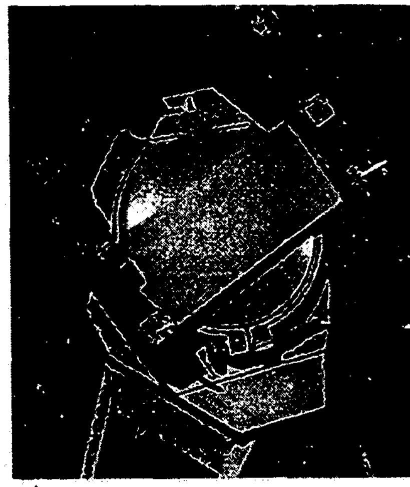
RICHARD FREDERICK

An Eye Patch for Your Scope

"I find it uncomfortable to hold one eye closed while observing," writes Richard Frederick (1563 Seashore Dr., Tacoma, WA 98465). Wearing an eye patch to keep out stray light is one remedy. Even better is his Cyclops Squint Prevention Device *(left)*, easily contrived from a pair of eye patches with the straps removed, heavy-gauge copper wire, and some electrical tape. After being wrapped in tape, the wire is bent to form a loop at the center that slides snugly onto the base of the telescope's focuser. The ends of the wire are then twisted into small coils and taped over, forming pads to which the patches can be affixed with Velcro. The wire around the focuser can easily be rotated to suit any orientation of the telescope. Having two patches makes it easy to switch from observing with one eye to the other.

Sliding Crayford Focuser

Cláudio Fabi (see the facing page) was not to be outdone in the focuser category either. At Stellafane his telescope sported a simple but practical variant of the Crayford design, perhaps best known today in the NGF series of precision focusers manufactured by Jim's Mobile Inc., but which originated many years ago with the English amateur John Wall (*S&T:* September 1974, page 182). Unlike a true Crayford, however, Fabi's focuser *(right)* contains not a single ball bearing; the eyepiece receptacle slides without play between an aluminum angle bracket and a flat plate. Attached to the receptacle is a short screw that projects through a slot in the plate and another slot in the convenient focusing lever.

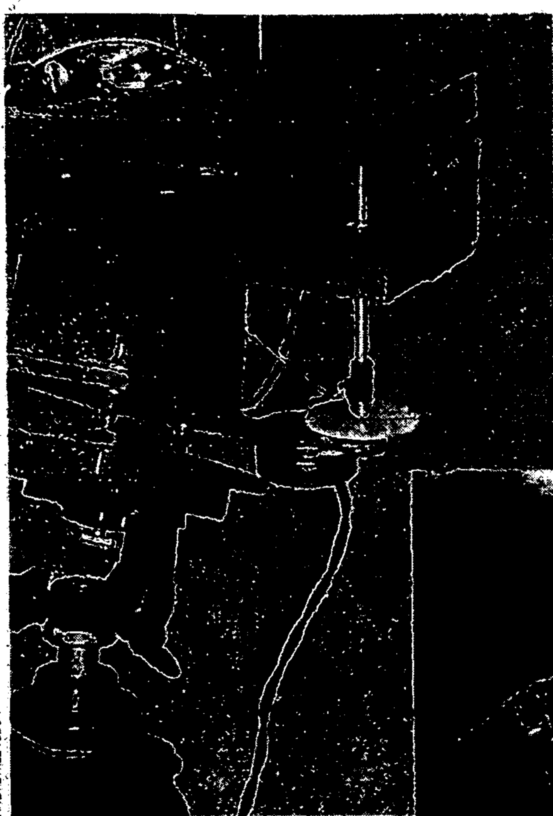


ERNIE PFANNENSCHMIDT

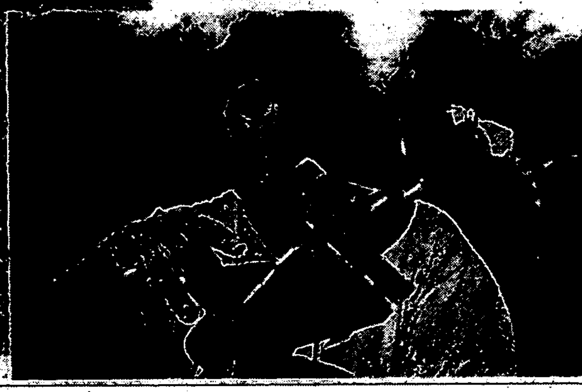
Quick-Change Mount

Veteran telescope maker Ernie Pfannenschmidt (1734 Fairfield Rd., Victoria, BC V8S 1G3, Canada) has always wanted a quick way to swap telescopes back and forth on a single, rugged, mount. Part of his recent solution is the use of standard pipe threads on one end of the 2-inch aluminum pipe that serves as the mount's declination shaft. Each of his telescopes is equipped with a floor-flange fitting that screws firmly into place. The pipe's other end is filled with lead as a counterweight, and round lead fishing weights can be hung on the end of the shaft, as needed, to fine-tune the balance. Moreover, the shaft itself disengages easily because it rides in split pillow-block bearings, made of cabinet-grade plywood, that swing apart on hinges. "This mount is so rugged" he notes, "that I can view a steady planetary image at 260× in a 15-mile-per-hour wind."

ERNIE PFANNENSCHMIDT



ANDRÉ MEDVEDEFF



Nonbinding Tangent Arms

Barndoor camera mounts have recently enjoyed a popularity spurt, thanks to the spectacular apparitions of comets Hyakutake and Hale-Bopp. The appeal is simplicity itself: a pair of boards with a hinge at one end and a motorized screw at the other for tracking the stars across the sky. But there's a rub — the builder must include some provision so the drive screw doesn't bind as the angle slowly changes between the boards. At Stellafane, Wayne Zuhl (717 Brookside Place, Cranford, NJ 07016-1645) showed his solution *(below)*, a tightly coiled but flexible spring between the motor shaft and the drive nut. Equally clever is the design that André Medvedeff (1822 Pennwood Circle W., Clearwater, FL 34616) recently sent to this magazine *(left)*. Instead of being bolted to the lower board, Medvedeff's motor is carried by the very threaded rod it turns. And since this rod passes through a T nut, its tilt can change slightly as the tracking proceeds. Meanwhile, a cord tied between the mount's base and the motor prevents the latter from rotating on its own.

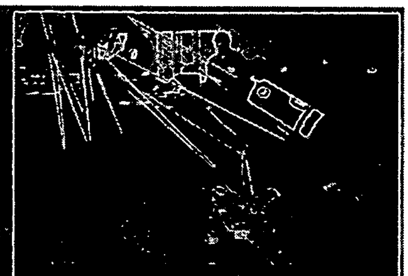
Motorizing a Dobsonian
Mel Bartels; Chuck Shaw
Sky and Telescope; Apr 2000; 99, 4; Research Library
pg. 128

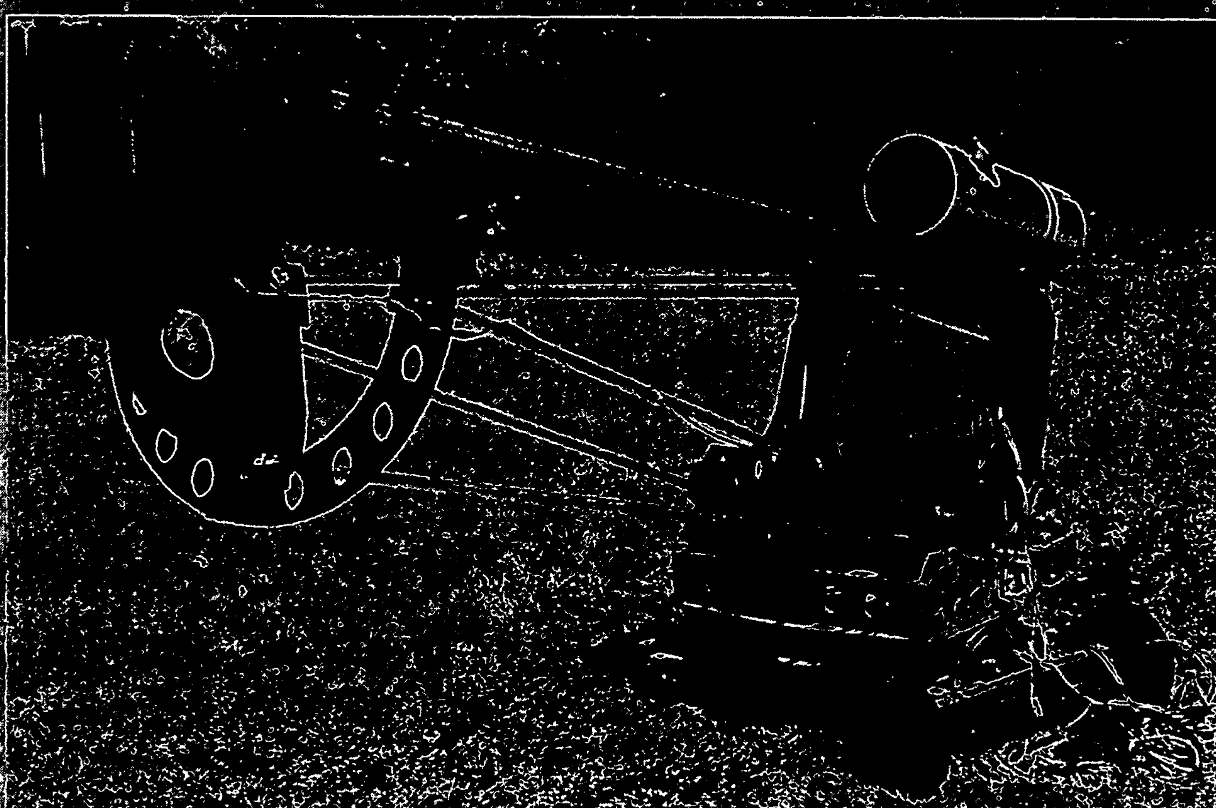
Motorizing a Dobsonian

Now the stability inherent in a simple altazimuth mount and the convenience of motorized tracking can be had at the same time. | **By Mel Bartels**

THE MODERN LIGHTWEIGHT Dobsonian is a marvelous instrument. Transportable to dark skies, its large, fast primary mirror, combined with highly corrected wide-angle eyepieces and nebula filters, provides spectacular views of the universe. However, the design is limited. The Dobsonian's inability to track objects means that magnifications greater than 500× are impractical. This is not only because of the difficulty of centering the telescope on the object but also because the scope will need to be recentered with annoying frequency. Making the situation worse, at typical f/ratios, the diffraction-limited field of view is only a few Jupiter diameters wide. Precisely recentering a planet every few seconds while anticipating those rare moments of steady seeing is a recipe for frustration.

Fortunately, it is possible to convert an ordinary Dobsonian into one with motorized tracking. This capability not only makes high-magnification viewing less difficult but also opens up the world of long-exposure imaging if a field derotator (a device that counteracts the field rotation present when tracking in altazimuth) is used. Public astronomy events are also far easier to manage since the



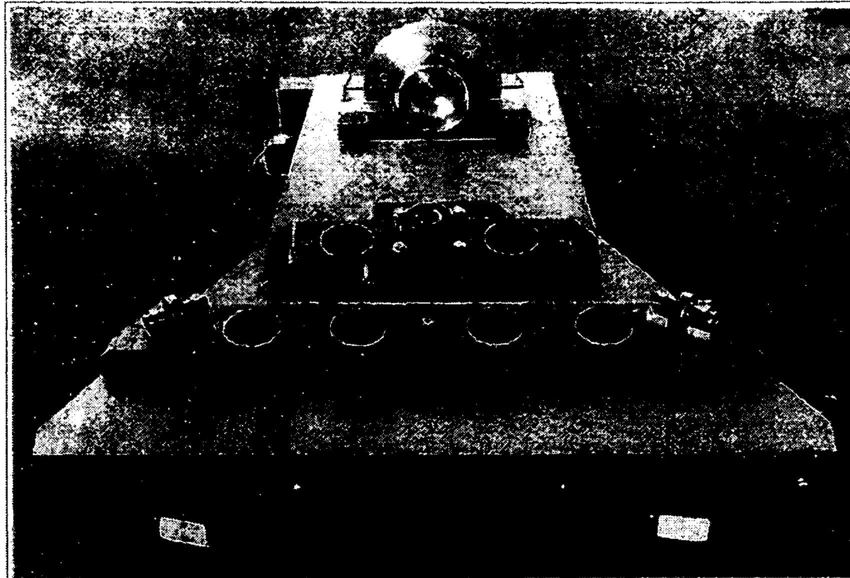


Below: By combining a Dobsonian telescope's inherent stability with computer control, Mel Bartels has the best of both worlds — big-aperture viewing with motorized tracking and GoTo on a solid vibration-free mount. *Right:* The author (*left*) discusses the fine points of motorized telescope control with a pair of interested bystanders at the Bellingham Telescope Optics Workshop.

telescope doesn't need to be recentered after each person has had a chance to view. And if we go to the trouble of motorizing our scope, it would be nice if it could also find targets on its own.

So what is involved in making a Dobsonian hunt and track? Because these are altazimuth scopes, this requires more than simply slapping a motor on one axis — you need to drive both axes at the same time and at varying rates. This complication is best handled by a portable computer armed with the appropriate software.

A simple *tracking* telescope has one motor if equatorial, or two if altazimuth. These motors act to cancel the Earth's rotation to keep an object in the eyepiece. A telescope that uses motors to slew across the sky is called a *motorized* scope. If the motors are under computer control, the telescope is described as, logically enough, *computer controlled*, *fully computerized*, or simply *computerized*. Commercial Go To telescopes fall into the latter category, as does the system outlined here.



Above: **This view of the scope's ground board shows the two opposed ball bearings that replaced the Teflon pads typically found in nonmotorized Dobsonians. The third contact point consists of a machined hub and a Byers gear driven by a stepper motor to provide azimuth motion.**

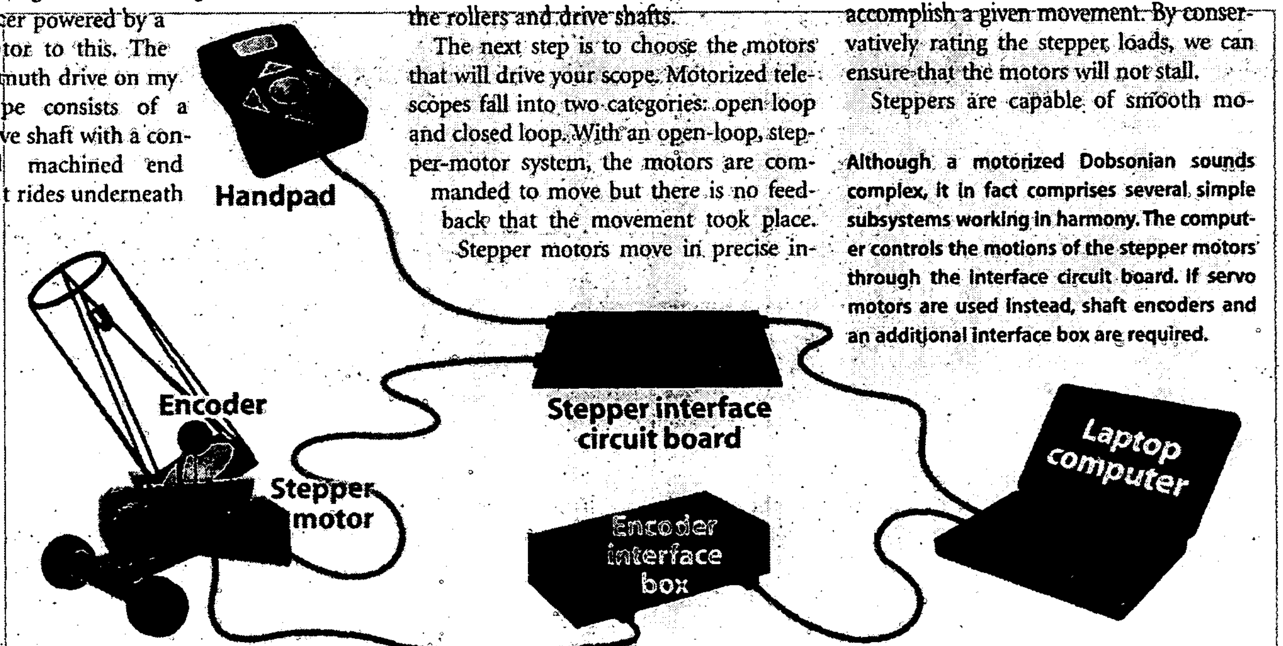
Right: **The low-profile rocker box of Bartels's 20-inch scope also features ball bearings in place of Teflon pads. In the foreground are the gear-and-motor assemblies that provide the scope's altitude and azimuth motions.**

Let the Modifications Begin

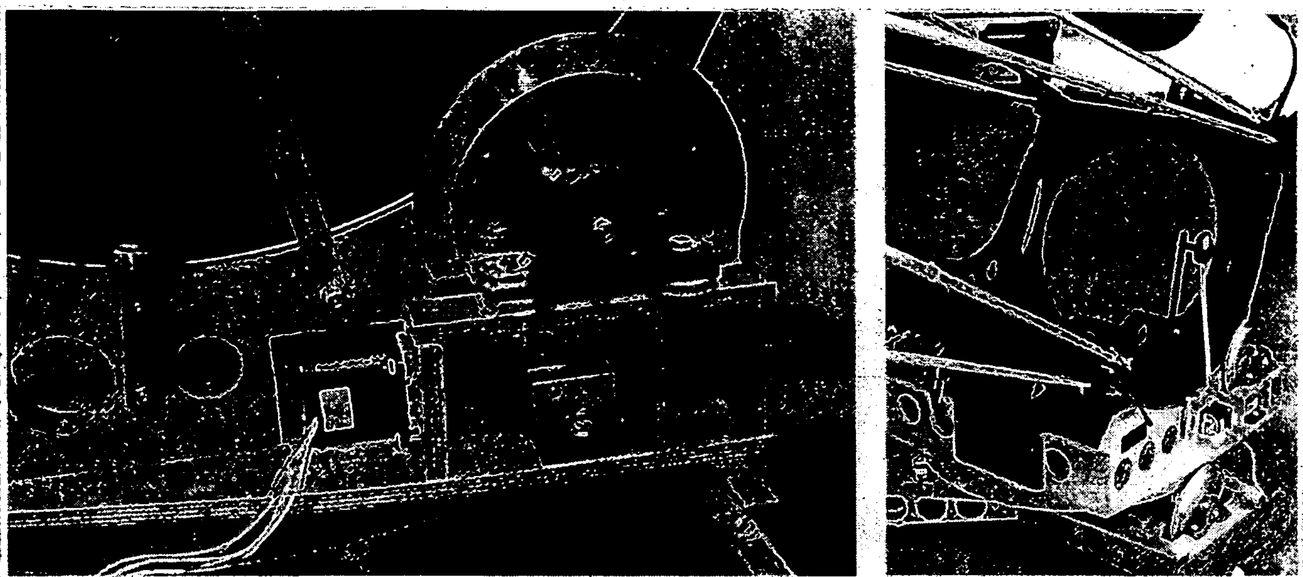
The Teflon-Formica bearings found in typical Dobsonians offer too much resistance for most drive motors to overcome. Consequently, the bearing surfaces should be changed to ball bearings riding against Formica for small scopes or against aluminum or galvanized sheet metal for larger instruments. Likewise, the side bearings will have to be faced with thin strips of aluminum. Substitute a drive wheel for one of the four altitude bearings and attach a gear reducer powered by a motor to this. The azimuth drive on my scope consists of a drive shaft with a conical machined end that rides underneath the rocker bottom. The other two contact points are ball bearings. One advantage of a Dobsonian over an equatorial mount is that gravity naturally tensions the rollers and drive shafts.

The next step is to choose the motors that will drive your scope. Motorized telescopes fall into two categories: open loop and closed loop. With an open-loop, stepper-motor system, the motors are commanded to move but there is no feedback that the movement took place. Stepper motors move in precise increments of (usually) 200 full steps per revolution. The computer's software simply calculates and then counts the number of steps required for each motor to accomplish a given movement. By conservatively rating the stepper loads, we can ensure that the motors will not stall.

Steppers are capable of smooth mo-



Although a motorized Dobsonian sounds complex, it in fact comprises several simple subsystems working in harmony. The computer controls the motions of the stepper motors through the interface circuit board. If servo motors are used instead, shaft encoders and an additional interface box are required.



Left: This close-up view shows the altitude drive assembly. *Right:* Bartels's scope is also equipped with a pair of shaft encoders. The altitude encoder is seen here (mounted on an aluminum bar attached to the rocker box). Although optional for a stepper-driver system, encoders provide positional information to the computer in case the scope is accidentally bumped.

tion if they move in small increments — microsteps — rather than whole or half steps. They can also be very quiet if their vibrations are isolated from wood and other resonant materials with a thin piece of rubber or Styrofoam. Further isolation can be accomplished by using nylon screws or bolts to attach the stepper to its mounting plate and by utilizing a short piece of automobile vacuum hose to attach the stepper to the gear reducer.

Steppers come in several varieties, denoted by the number of phases. Two-phase steppers are called bipolar and require two special drivers called half-bridges. Most common is the four-phase or unipolar stepper. This is the type most commercial driver kits use. Unipolar steppers are usually (but not always) distinguished by the fact that they have five

Using a Motorized Dob

By Chuck Shaw

Whenever I use my scope in the company of others, people invariably comment on how "complex" it looks, "with a computer and all...." True, a computer screen looks pretty impressive and there is something about electronic giblets attached to a printed circuit board that seems to inspire awe. Watching the scope slew quietly from target to target reinforces the impression of a sophisticated machine at work. However, the truth is that this impressive display is really the product of simple subsystems working together to make observing with this scope a very user-friendly experience. Even though this system is capable of performing a variety of tasks, one does not need to learn all of them to use the telescope for basic observing.

To begin a night of observing, I attach my laptop to the two connectors from the scope's drive. For basic visual observing I use an ancient and inexpensive 20-MHz 386. I turn on the computer and power up the scope when the screen instructs me to. Next, I need to tell the computer the scope's current altitude and azimuth orientations. I do this by pointing the telescope north and then by aiming it straight up until it contacts a bumper. Once the scope is positioned this way, I hit a couple of keys to update the computer's software. I continue by aiming the scope at an alignment star and flipping a switch on the hand controller to let the computer know that the star is centered. The procedure is simplified by selecting a star from the computer's database. I can repeat this procedure with a second and even a third star to further refine the scope's alignment.

If I want the scope to follow a star and don't need the Go To capability, no alignment procedure is required — I allow my target to drift a minute or so, recenter it, and then flip the hand-control switch. The scope will magically keep it centered! To slew to a selected NGC or Messier object in the database, two- or three-star initialization is necessary. Fortunately, this takes only a moment to do. Alternatively, one can manually move the scope to the desired object and simply restart tracking.

For me, this system has had its biggest impact on my CCD-imaging endeavors. Since I do not have a permanent observatory in my light-polluted Houston, Texas, backyard, I used to spend a significant part of my evening accurately polar-aligning my equatorial platform. Now I simply roll out

or more leads. In addition, there are also three-phase and five-phase steppers. My software will handle five-phase motors but the user must customize the drive circuit slightly. Five-phase steppers are extremely well made and very accurate. Motors rated between 6 and 12 volts work best with most systems, including mine.

If servo motors are chosen instead of steppers, some sort of feedback loop is necessary for the computer to keep track of motion since, unlike stepper motors, servos don't move in precise, countable steps. A tachometer or shaft encoder will provide this information but at the price of more complex hardware and software. In practice, both methods work well but open-loop steppers are a little easier to control.

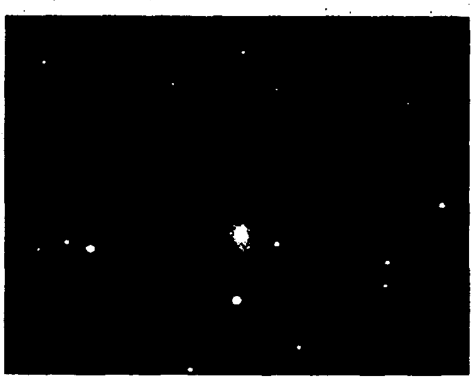
While it is true that just about any Dobsonian can be motorized, most are built only to the construction standards necessary for manual point-and-shoot observing. This is why typical Dobsonians equipped with digital setting circles fail to achieve better than 1° accuracy in aiming. For better precision, meeting tighter construction tolerances is a must. To ensure that altitude bearings are reliably round, cut them with a router and a circle-cutting jig. It is also important to check that they are parallel to each other when attached to the mirror box sides. The mirror box itself must be built exactly square so that the four altitude bearing points form a rectangle, not a parallelogram. These points must also be the same height above the rocker base. Such precautions will ensure that the two axes of motion are close to perpendicular. Software such as *TPoint* and my own freeware pointing software can analyze and compensate for the remaining errors.

Brainpower in a Box

Because altitude and azimuth drive rates change depending on where the scope is aimed, some sort of constantly varying motor control is necessary. My system relies on an inexpensive laptop or PC to calculate drive rates in real time. The stepper motors are controlled via pulse-width modulation through a simple power amplifier circuit (available at my Web site) connected via the computer's parallel port. Motor speed can vary from 20 microsteps per full-step tracking to high-speed slewing up to 1,800 rpm.

The software I wrote for this project has been in continuous development for the scope, start the laptop, complete the three-star initialization, and I'm ready to go in less than 10 minutes. While the CCD camera cools, I sight on a star to simultaneously focus the camera and make small tracking adjustments to cancel any residual drift. I'm now ready to start taking 30-second unguided shots, 90 percent of which will be keepers! If I refine the residual drift as I acquire images, I can extend the duration of the unguided exposures to 60 seconds and still have 80 to 90 percent of the images turn out. The secret to consistently getting this level of performance lies with the software's ability to compensate for the mechanical imperfections of the mount and drive system.

John Dobson's revolutionary approach to telescope making brought large-aperture views to more and more people. Building on the elegant simplicity of the Dobsonian mount by adding motorized computer control seems an appropriate way to continue the revolution he began.



CHUCK SHAW

Opposite page: **Telescope maker Chuck Shaw sits beside his computerized 14½-inch f/5 Dobsonian. A fine instrument for visual work, Shaw's scope is also wired for CCD imaging, for which he uses an old 25-MHz 486 laptop computer. The field derotator can be seen attached to the focuser.**

Left: **For this CCD image of the face-on spiral M101 in Ursa Major, Shaw used his 14½-inch scope to obtain 106 individual 30-second unguided exposures. These exposures were combined digitally using *Adobe Photoshop*.**

CHUCK SHAW *is an avid telescope maker and CCD imager. He maintains a Web site at www.ghg.net/cshaw.*

Getting the Goods

The Internet is a rich source of information for telescope enthusiasts — especially those seeking to motorize their Dobsonian telescopes. Here are a few sites featuring noteworthy ideas and miscellaneous construction hints.

Amateur systems

Mel Bartels:
http://zebu.uoregon.edu/~mbartels/altaz/altaz.html
MacDOB:
http://chemwww.cwru.edu/~das//macdob/MacDob.html
Robert Soubie: www.atlantic-line.fr/~soubie/axes.htm
Make your own drive gear:
http://easyweb.easynet.co.uk/~chrish/worms.htm
Tom Krajci's nylon rod drive setup: http://zebu.uoregon.edu/~mbartels/altaz/homemade_gears.html
Don Clement's cable drive system:
www.inetworld.net/clement/cabledrive.html

Commercial systems

Tech2000 Dob DriverII: www.accnorwalk.com/~tddi/tech2000/
SkyProbe 1000: www.soft-tec.com/skyprobe/index.html
Quadrant: www.qei-motion.com/
Deep Space Navigator drive:
http://ourworld.compuserve.com/homepages/dsnavigator/

Encoders

Part number S2-2048-B from US Digital, seller of Hewlett-Packard encoders.

Gear reducers

Torque Transmissions (TorqueTran@aol.com, 216-352-8995)
Allied Devices (516-223-9100)
Andy Saulietis's hard plastic gear reducers (iss@pvtnetworks.net)
Larry Myers's Byers gears (www.mountaininstruments.com or larrym@foothill.net)
Dave Radosevich's Byers gears (Dave_Radosevich@qmail4.nba.TRW.COM)
American Science and Surplus (www.sciplus.com); look for motors with gear heads for about $5 — remove the motor
MECI (www.meci.com); gear motors for $10 — remove the motor
Harmonic Drives (www.sfnet.net/candycontrols/hdc_po.html and www.harmonic-drive.com/)

Stepper motors

Surplus stocks are a moving target! Look for steppers at surplus houses such as:

Wacky Willy's Surplus in Portland, Oregon (503-234-6864 or 503-642-5111)
C & H Sales (800-325-9465) www.aaaim.com/CandH/index.htm
Herbach and Rademan (800-848-8001 orders, 215-788-5583 catalog)
Gateway Electronics in San Diego (619-279-6802), motor part Slo-Syn M061-FDD2 35 oz-in 5V@1A ¼" shaft with 6 leads, $9 each
Marlin P. Jones Associates (www.mpja.com) is also a source of inexpensive half-step unipolar stepper-driver units.
Jameco (800-831-4242)
Alltronics (http://alltronics.com/)
SVKits.com

more than 10 years and offers an extensive suite of features for precision tracking and slewing, including refraction, drift, and backlash compensation. Periodic error can be calculated on the fly from a guiding session. The program will accept commands on a serial link, mimicking an LX200-type telescope, so that planetarium programs with their graphical point-and-click interface can control the software. Best of all, the software is free for downloading at my Web site. In the finest tradition of the Internet, many have contributed bits and pieces to the puzzle, including a hundred data files.

Every telescope-modification project has its own peculiar considerations. I encourage you to have a look at the approaches others have used before you dig in — learn from their efforts. Visit the Web sites listed above and take the plunge. You won't regret it.

A former orchestral musician and teacher, Mel Bartels *has worked as a programmer and systems manager for the past 10 years. He has ground about 100 mirrors and for the past dozen years has built computerized control systems for telescopes.*

A Low-Tech Motor System

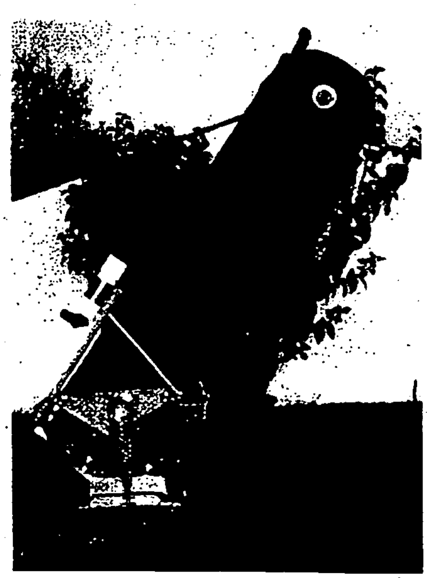
By Gary Wolanski

After completing my lightweight 16-inch altazimuth scope (*S&T:* August 1999, page 128), I found that I missed the tracking capability of my old telescope's equatorial mount — especially when it came to high-magnification planetary viewing. This motivated me to develop a low-tech solution that I lightheartedly refer to as VADS — the Visual Assist Drive System. VADS shows that an altazimuth scope can be driven without using interface boxes, a computer, stepper motors, or even big and heavy batteries. Furthermore, VADS does not require polar alignment or a multistar setup procedure.

At first, regulating the constantly changing movement of two axes sounded like a task only a computer could perform. However, I soon realized that there should be sufficiently long periods of time during which two drive motors running at constant (but different) rates could track accurately enough to allow satisfying high-magnification planetary views. On a whim I set out to confirm this suspicion by simply driving the scope in azimuth.

I already had a disk of 0.08-inch-thick aluminum left over from building the scope's secondary cage, so I strapped it to

Gary Wolanski's 16-inch lightweight Dobsonian was featured in the August 1999 issue. Since that article appeared, Wolanski has added a low-tech altazimuth tracking system.


GARY WOLANSKI